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(54) **SHOWERHEAD WITH TURBINE DRIVEN SHUTTER**

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(56) **References Cited**

U.S. PATENT DOCUMENTS

203,094	A	4/1878	Wakeman
204,333	A	5/1878	Josias

(Continued)

FOREIGN PATENT DOCUMENTS

CA	659510	3/1963
CA	2341041	8/1999

(Continued)

OTHER PUBLICATIONS

Author Unknown, "Flipside: The Bold Look of Kohler," 1 page, at least as early as Jun. 2011.

(Continued)

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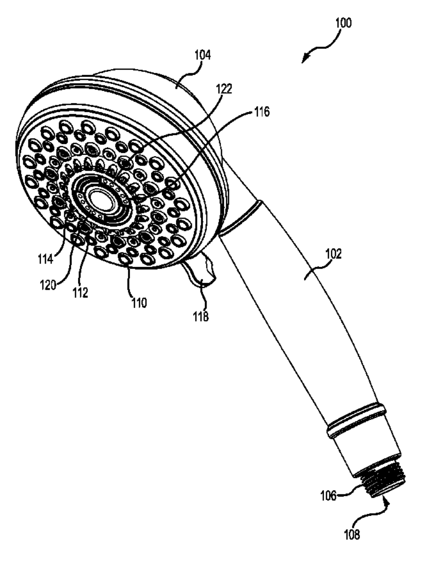
(57) **ABSTRACT**

The present disclosure includes embodiments directed to a showerhead. In some of the embodiments, the showerhead includes a housing defining a chamber in fluid communication with a fluid inlet such as a water source, a first bank of nozzles, and a second bank of nozzles. The showerhead also includes a massage mode assembly that is at least partially received within the chamber. The massage mode assembly includes a turbine, a cam connected to or formed integrally with the turbine, and a shutter connected to the cam. With the structure of the massage mode assembly, the movement of the shutter is restricted along a single axis such that as the turbine rotates, the cam causes the shutter to alternatingly fluidly connect and disconnect the first bank of nozzles and the second bank of nozzles from the fluid inlet.

9 Claims, 32 Drawing Sheets



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(56) **References Cited**

U.S. PATENT DOCUMENTS

309,349	A	12/1884	Hart
428,023	A	5/1890	Schoff
432,712	A	7/1890	Taylor
445,250	A	1/1891	Lawless
453,109	A	5/1891	Dreisorner
486,986	A	11/1892	Schinke
566,384	A	8/1896	Engelhart
566,410	A	8/1896	Schinke
570,405	A	10/1896	Jerguson et al.
694,888	A	3/1902	Pfluger
800,802	A	10/1905	Franquist
832,523	A	10/1906	Andersson
835,678	A	11/1906	Hammond
845,540	A	2/1907	Ferguson
854,094	A	5/1907	Klein
926,929	A	7/1909	Dusseau
1,001,842	A	8/1911	Greenfield
1,003,037	A	9/1911	Crowe
1,018,143	A	2/1912	Vissering
1,046,573	A	12/1912	Ellis
1,130,520	A	3/1915	Kenney
1,203,466	A	10/1916	Benson
1,217,254	A	2/1917	Winslow
1,218,895	A	3/1917	Porter
1,255,577	A	2/1918	Berry
1,260,181	A	3/1918	Garnero
1,276,117	A	8/1918	Riebe
1,284,099	A	11/1918	Harris
1,327,428	A	1/1920	Gregory
1,451,800	A	4/1923	Agner
1,459,582	A	6/1923	Dubee
1,469,528	A	10/1923	Owens
1,500,921	A	7/1924	Bramson et al.
1,560,789	A	11/1925	Johnson et al.
1,597,477	A	8/1926	Panhorst
1,633,531	A	6/1927	Keller
1,669,949	A	5/1928	Reynolds
1,692,394	A	11/1928	Sundh
1,695,263	A	12/1928	Jacques
1,724,147	A	8/1929	Russell
1,724,161	A	8/1929	Wuesthoff
1,736,160	A	11/1929	Jonsson
1,754,127	A	4/1930	Srulowitz
1,758,115	A	5/1930	Kelly
1,778,658	A	10/1930	Baker
1,821,274	A	9/1931	Plummer
1,849,517	A	3/1932	Fraser
1,890,156	A	12/1932	Konig
1,906,575	A	5/1933	Goeriz
1,934,553	A	11/1933	Mueller et al.
1,946,207	A	2/1934	Haire
2,011,446	A	8/1935	Judell
2,024,930	A	12/1935	Judell
2,033,467	A	3/1936	Groeniger
2,044,445	A	6/1936	Price et al.
2,085,854	A	7/1937	Hathaway et al.
2,096,912	A	10/1937	Morris
2,117,152	A	5/1938	Crosti
D113,439	S	2/1939	Reinecke
2,196,783	A	4/1940	Shook
2,197,667	A	4/1940	Shook
2,216,149	A	10/1940	Weiss
D126,433	S	4/1941	Enthof
2,251,192	A	7/1941	Krumsiek et al.
2,268,263	A	12/1941	Newell et al.
2,285,831	A	6/1942	Pennypacker
2,342,757	A	2/1944	Roser
2,402,741	A	6/1946	Draviner
D147,258	S	8/1947	Becker
D152,584	S	2/1949	Becker
2,467,954	A	4/1949	Becker
2,518,709	A	8/1950	Mosby, Jr.
2,546,348	A	3/1951	Schuman
2,567,642	A	9/1951	Penshaw
2,581,129	A	1/1952	Muldoon
D166,073	S	3/1952	Dunkelberger
2,648,762	A	8/1953	Dunkelberger
2,664,271	A	12/1953	Arutunoff
2,671,693	A	3/1954	Hyser et al.
2,676,806	A	4/1954	Bachman
2,679,575	A	5/1954	Haberstump
2,680,358	A	6/1954	Zublin
2,726,120	A	12/1955	Bletcher et al.
2,759,765	A	8/1956	Pawley
2,776,168	A	1/1957	Schweda
2,792,847	A	5/1957	Spencer
2,873,999	A	2/1959	Webb
2,930,505	A	3/1960	Meyer
2,931,672	A	4/1960	Merritt et al.
2,935,265	A	5/1960	Richter
2,949,242	A	8/1960	Blumberg et al.
2,957,587	A	10/1960	Tobin
2,966,311	A	12/1960	Davis
D190,295	S	5/1961	Becker
2,992,437	A	7/1961	Nelson et al.
3,007,648	A	11/1961	Fraser
D192,935	S	5/1962	Becker
3,032,357	A	5/1962	Shames et al.
3,034,809	A	5/1962	Greenberg
3,037,799	A	6/1962	Mulac
3,081,339	A	3/1963	Green et al.
3,092,333	A	6/1963	Gaiotto
3,098,508	A	7/1963	Gerdes
3,103,723	A	9/1963	Becker
3,104,815	A	9/1963	Schultz
3,104,827	A	9/1963	Aghnides
3,111,277	A	11/1963	Grimsley
3,112,073	A	11/1963	Larson et al.
3,143,857	A	8/1964	Eaton
3,196,463	A	7/1965	Farneth
3,231,200	A	1/1966	Heald
3,236,545	A	2/1966	Parkes et al.
3,239,152	A	3/1966	Bachli et al.
3,266,059	A	8/1966	Stelle
3,272,437	A	9/1966	Coson
3,273,359	A	9/1966	Fregeolle
3,306,634	A	2/1967	Groves et al.
3,323,148	A	6/1967	Burnon
3,329,967	A	7/1967	Martinez et al.
3,341,132	A	9/1967	Parkison
3,342,419	A	9/1967	Weese
3,344,994	A	10/1967	Fife
3,363,842	A	1/1968	Burns
3,383,051	A	5/1968	Fiorentino
3,389,925	A	6/1968	Gottschald
3,393,311	A	7/1968	Dahl
3,393,312	A	7/1968	Dahl
3,404,410	A	10/1968	Sumida
3,492,029	A	1/1970	French et al.
3,516,611	A	6/1970	Piggott
3,546,961	A	12/1970	Marton
3,550,863	A	12/1970	McDermott
3,552,436	A	1/1971	Stewart
3,565,116	A	2/1971	Gabin
3,566,917	A	3/1971	White
3,580,513	A	5/1971	Martin
3,584,822	A	6/1971	Oram
3,596,835	A	8/1971	Smith et al.
3,612,577	A	10/1971	Pope
3,637,143	A	1/1972	Shames et al.
3,641,333	A	2/1972	Gendron
3,647,144	A	3/1972	Parkison et al.
3,663,044	A	5/1972	Contreras et al.
3,669,470	A	6/1972	Deurloo
3,672,648	A	6/1972	Price
3,682,392	A	8/1972	Kint
3,685,745	A	8/1972	Peschcke-koedt
D224,834	S	9/1972	Laudell

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,711,029 A	1/1973	Bartlett	
3,722,798 A	3/1973	Bletcher et al.	
3,722,799 A	3/1973	Rauh	
3,731,084 A	5/1973	Trevorrow	
3,754,779 A	8/1973	Peress	
D228,622 S	10/1973	Juhlin	
3,762,648 A	10/1973	Deines et al.	
3,768,735 A	10/1973	Ward	
3,786,995 A	1/1974	Manoogian et al.	
3,801,019 A	4/1974	Trenary et al.	
3,810,580 A	5/1974	Rauh	
3,826,454 A	7/1974	Zieger	
3,840,734 A	10/1974	Oram	
3,845,291 A	10/1974	Portyrata	
3,860,271 A	1/1975	Rodgers	
3,861,719 A	1/1975	Hand	
3,865,310 A	2/1975	Elkins et al.	
3,869,151 A	3/1975	Fletcher et al.	
3,887,136 A	6/1975	Anderson	
3,896,845 A	7/1975	Parker	
3,902,671 A	9/1975	Symmons	
3,910,277 A	10/1975	Zimmer	
D237,708 S	11/1975	Grohe	
3,929,164 A	12/1975	Richter	
3,929,287 A	12/1975	Givler et al.	
3,958,756 A	5/1976	Trenary et al.	
D240,322 S	6/1976	Staub	
3,963,179 A	6/1976	Tomaro	
3,967,783 A	7/1976	Halsted et al.	
3,979,096 A	9/1976	Zieger	
3,997,116 A	12/1976	Moen	
3,998,390 A	12/1976	Peterson et al.	
3,999,714 A	12/1976	Lang	
4,005,880 A	2/1977	Anderson et al.	
4,006,920 A	2/1977	Sadler et al.	
4,023,782 A	5/1977	Eifer	
4,042,984 A	8/1977	Butler	
4,045,054 A	8/1977	Arnold	
D245,858 S	9/1977	Grube	
D245,860 S	9/1977	Grube	
4,068,801 A	1/1978	Leutheuser	
4,081,135 A	3/1978	Tomaro	
4,084,271 A	4/1978	Ginsberg	
4,091,998 A	5/1978	Peterson	
D249,356 S	9/1978	Nagy	
4,117,979 A	10/1978	Lagarelli et al.	
4,129,257 A	12/1978	Eggert	
4,130,120 A	12/1978	Kohler, Jr.	
4,131,233 A	12/1978	Koenig	
4,133,486 A	1/1979	Fanella	
4,135,549 A	1/1979	Baker	
D251,045 S	2/1979	Grube	
4,141,502 A	2/1979	Grohe	
4,151,955 A	5/1979	Stouffer	
4,151,957 A	5/1979	Gecewicz et al.	
4,162,801 A	7/1979	Kresky et al.	
4,165,837 A	8/1979	Rundzaitis	
4,167,196 A	9/1979	Morris	
4,174,822 A	11/1979	Larsson	
4,185,781 A	1/1980	O'Brien	
4,190,207 A	2/1980	Fienhold et al.	
4,191,332 A	3/1980	De Langis et al.	
4,203,550 A	5/1980	On	
4,209,132 A	6/1980	Kwan	
D255,626 S	7/1980	Grube	
4,219,160 A	8/1980	Allred, Jr.	
4,221,338 A	9/1980	Shames et al.	
4,239,409 A	12/1980	Osrwo	
4,243,253 A	1/1981	Rogers, Jr.	
4,244,526 A	1/1981	Arth	
D258,677 S	3/1981	Larsson	
4,254,914 A	3/1981	Shames et al.	
4,258,414 A	3/1981	Sokol	
4,272,022 A	6/1981	Evans	
4,274,400 A	6/1981	Baus	
4,275,843 A	6/1981	Moen	
4,282,612 A	8/1981	King	
D261,300 S	10/1981	Klose	
D261,417 S	10/1981	Klose	
4,303,201 A	12/1981	Elkins et al.	
4,319,608 A	3/1982	Raikov et al.	
4,324,364 A *	4/1982	Buzzi	B05B 1/1627 239/381
4,330,089 A	5/1982	Finkbeiner	
D266,212 S	9/1982	Haug et al.	
4,350,298 A	9/1982	Tada	
4,353,508 A	10/1982	Butterfield et al.	
4,358,056 A	11/1982	Greenhut et al.	
D267,582 S	1/1983	Mackay et al.	
D268,359 S	3/1983	Klose	
D268,442 S	3/1983	Darmon	
D268,611 S	4/1983	Klose	
4,383,554 A	5/1983	Merriman	
4,396,797 A	8/1983	Sakuragi et al.	
4,398,669 A	8/1983	Fienhold	
4,425,965 A	1/1984	Bayh, III et al.	
4,432,392 A	2/1984	Paley	
D274,457 S	6/1984	Haug	
4,461,052 A	7/1984	Mostul	
4,465,308 A	8/1984	Martini	
4,467,964 A	8/1984	Kaeser	
4,495,550 A	1/1985	Visciano	
4,527,745 A	7/1985	Butterfield et al.	
4,540,202 A	9/1985	Amphoux et al.	
4,545,081 A	10/1985	Nestor et al.	
4,553,775 A	11/1985	Halling	
D281,820 S	12/1985	Oba et al.	
4,561,593 A	12/1985	Cammack et al.	
4,564,889 A	1/1986	Bolson	
4,571,003 A	2/1986	Roling et al.	
4,572,232 A	2/1986	Gruber	
D283,645 S	4/1986	Tanaka	
4,587,991 A	5/1986	Chorkey	
4,588,130 A	5/1986	Trenary et al.	
4,598,866 A	7/1986	Cammack et al.	
4,614,303 A	9/1986	Moseley, Jr. et al.	
4,616,298 A	10/1986	Bolson	
4,618,100 A	10/1986	White et al.	
4,629,124 A	12/1986	Gruber	
4,629,125 A	12/1986	Liu	
4,643,463 A	2/1987	Halling et al.	
4,645,244 A	2/1987	Curtis	
RE32,386 E	3/1987	Hunter	
4,650,120 A	3/1987	Kress	
4,650,470 A	3/1987	Epstein	
4,652,025 A	3/1987	Conroy, Sr.	
4,654,900 A	4/1987	McGhee	
4,657,185 A	4/1987	Rundzaitis	
4,669,666 A	6/1987	Finkbeiner	
4,669,757 A	6/1987	Bartholomew	
4,674,687 A	6/1987	Smith et al.	
4,683,917 A	8/1987	Bartholomew	
4,703,893 A	11/1987	Gruber	
4,717,180 A	1/1988	Roman	
4,719,654 A	1/1988	Blessing	
4,733,337 A	3/1988	Bieberstein	
D295,437 S	4/1988	Fabian	
4,739,801 A	4/1988	Kimura et al.	
4,749,126 A	6/1988	Kessener et al.	
D296,582 S	7/1988	Haug et al.	
4,754,928 A	7/1988	Rogers et al.	
D297,160 S	8/1988	Robbins	
4,764,047 A	8/1988	Johnston et al.	
4,778,104 A	10/1988	Fisher	
4,778,111 A	10/1988	Leap	
4,787,591 A	11/1988	Villacorta	
4,790,294 A	12/1988	Allred, III et al.	
4,801,091 A	1/1989	Sandvik	
4,809,369 A	3/1989	Bowden	
4,839,599 A	6/1989	Fischer	
4,841,590 A	6/1989	Terry	
4,842,059 A	6/1989	Tomek	
D302,325 S	7/1989	Charet et al.	
4,850,616 A	7/1989	Pava	

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,854,499	A	8/1989	Neuman
4,856,822	A	8/1989	Parker
4,865,362	A	9/1989	Holden
D303,830	S	10/1989	Ramsey et al.
4,871,196	A	10/1989	Kingsford
4,896,658	A	1/1990	Yonekubo et al.
D306,351	S	2/1990	Charet et al.
4,901,927	A	2/1990	Valdivia
4,903,178	A	2/1990	Englot et al.
4,903,897	A	2/1990	Hayes
4,903,922	A	2/1990	Harris, III
4,907,137	A	3/1990	Schladitz et al.
4,907,744	A	3/1990	Jousson
4,909,435	A	3/1990	Kidouchi et al.
4,914,759	A	4/1990	Goff
4,946,202	A	8/1990	Perricone
4,951,329	A	8/1990	Shaw
4,953,585	A	9/1990	Rollini et al.
4,964,573	A	10/1990	Lipski
4,972,048	A	11/1990	Martin
D313,267	S	12/1990	Lenci et al.
4,976,460	A	12/1990	Newcombe et al.
D314,246	S	1/1991	Bache
D315,191	S	3/1991	Mikol
4,998,673	A	3/1991	Pilolla
5,004,158	A	4/1991	Halem et al.
D317,348	S	6/1991	Geneve et al.
5,020,570	A	6/1991	Cotter
5,022,103	A	6/1991	Faist
5,032,015	A	7/1991	Christianson
5,033,528	A	7/1991	Volcani
5,033,897	A	7/1991	Chen
D319,294	S	8/1991	Kohler, Jr. et al.
D320,064	S	9/1991	Presman
5,046,764	A	9/1991	Kimura et al.
D321,062	S	10/1991	Bonbright
5,058,804	A	10/1991	Yonekubo et al.
D322,119	S	12/1991	Haug et al.
D322,681	S	12/1991	Yuen
5,070,552	A	12/1991	Gentry et al.
D323,545	S	1/1992	Ward
5,082,019	A	1/1992	Tetrault
5,086,878	A	2/1992	Swift
5,090,624	A	2/1992	Rogers
5,100,055	A	3/1992	Rokitenetz et al.
D325,769	S	4/1992	Haug et al.
D325,770	S	4/1992	Haug et al.
5,103,384	A	4/1992	Drohan
D326,311	S	5/1992	Lenci et al.
D327,115	S	6/1992	Rogers
5,121,511	A	6/1992	Sakamoto et al.
D327,729	S	7/1992	Rogers
5,127,580	A	7/1992	Fu-I
5,134,251	A	7/1992	Martin
D328,944	S	8/1992	Robbins
5,141,016	A	8/1992	Nowicki
D329,504	S	9/1992	Yuen
5,143,300	A	9/1992	Cutler
5,145,114	A	9/1992	Monch
5,148,556	A	9/1992	Bottoms et al.
D330,068	S	10/1992	Haug et al.
D330,408	S	10/1992	Thacker
D330,409	S	10/1992	Raffo
5,153,976	A	10/1992	Benchaar et al.
5,154,355	A	10/1992	Gonzalez
5,154,483	A	10/1992	Zeller
5,161,567	A	11/1992	Humpert
5,163,752	A	11/1992	Copeland et al.
5,171,429	A	12/1992	Yasuo
5,172,860	A	12/1992	Yuch
5,172,862	A	12/1992	Heimann et al.
5,172,866	A	12/1992	Ward
D332,303	S	1/1993	Klose
D332,994	S	2/1993	Huen
D333,339	S	2/1993	Klose
5,197,767	A	3/1993	Kimura et al.
D334,794	S	4/1993	Klose
D335,171	S	4/1993	Lenci et al.
5,201,468	A	4/1993	Freier et al.
5,206,963	A	5/1993	Wiens
5,207,499	A	5/1993	Vajda et al.
5,213,267	A	5/1993	Heimann et al.
5,220,697	A	6/1993	Birchfield
D337,839	S	7/1993	Zeller
5,228,625	A	7/1993	Grassberger
5,230,106	A	7/1993	Henkin et al.
D338,542	S	8/1993	Yuen
5,232,162	A	8/1993	Chih
D339,492	S	9/1993	Klose
D339,627	S	9/1993	Klose
D339,848	S	9/1993	Gottwald
5,246,169	A	9/1993	Heimann et al.
5,246,301	A	9/1993	Hirasawa
D340,376	S	10/1993	Klose
5,253,670	A	10/1993	Perrott
5,253,807	A	10/1993	Newbegin
5,254,809	A	10/1993	Martin
D341,007	S	11/1993	Haug et al.
D341,191	S	11/1993	Klose
D341,220	S	11/1993	Eagan
5,263,646	A	11/1993	McCauley
5,265,833	A	11/1993	Heimann et al.
5,268,826	A	12/1993	Greene
5,276,596	A	1/1994	Krenzel
5,277,391	A	1/1994	Haug et al.
5,286,071	A	2/1994	Storage
5,288,110	A	2/1994	Allread
5,294,054	A	3/1994	Benedict et al.
5,297,735	A	3/1994	Heimann et al.
5,297,739	A	3/1994	Allen
D345,811	S	4/1994	Van Deursen et al.
D346,426	S	4/1994	Warshawsky
D346,428	S	4/1994	Warshawsky
D346,430	S	4/1994	Warshawsky
D347,262	S	5/1994	Black et al.
D347,265	S	5/1994	Gottwald
5,316,216	A	5/1994	Cammack et al.
D348,720	S	7/1994	Haug et al.
5,329,650	A	7/1994	Zaccai et al.
D349,947	S	8/1994	Hing-Wah
5,333,787	A	8/1994	Smith et al.
5,333,789	A	8/1994	Garneys
5,340,064	A	8/1994	Heimann et al.
5,340,165	A	8/1994	Sheppard
D350,808	S	9/1994	Warshawsky
5,344,080	A	9/1994	Matsui
5,349,987	A	9/1994	Shieh
5,356,076	A	10/1994	Bishop
5,356,077	A	10/1994	Shames
D352,092	S	11/1994	Warshawsky
D352,347	S	11/1994	Dannenberg
D352,766	S	11/1994	Hill et al.
5,368,235	A	11/1994	Drozdoff et al.
5,369,556	A	11/1994	Zeller
5,370,427	A	12/1994	Hoelle et al.
5,385,500	A	1/1995	Schmidt
D355,242	S	2/1995	Warshawsky
D355,703	S	2/1995	Duell
D356,626	S	3/1995	Wang
5,397,064	A	3/1995	Heitzman
5,398,872	A	3/1995	Joubran
5,398,977	A	3/1995	Berger et al.
5,402,812	A	4/1995	Moineau et al.
5,405,089	A	4/1995	Heimann et al.
5,414,879	A	5/1995	Hiraishi et al.
5,423,348	A	6/1995	Jezek et al.
5,433,384	A	7/1995	Chan et al.
D361,399	S	8/1995	Carbone et al.
D361,623	S	8/1995	Huen
5,441,075	A	8/1995	Clare
5,449,206	A	9/1995	Lockwood
D363,360	S	10/1995	Santarsiero
5,454,809	A	10/1995	Janssen
5,468,057	A	11/1995	Megerle et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

D364,935	S	12/1995	deBlois
D365,625	S	12/1995	Bova
D365,646	S	12/1995	deBlois
5,476,225	A	12/1995	Chan
D366,309	S	1/1996	Huang
D366,707	S	1/1996	Kaiser
D366,708	S	1/1996	Santarsiero
D366,709	S	1/1996	Szymanski
D366,710	S	1/1996	Szymanski
5,481,765	A	1/1996	Wang
D366,948	S	2/1996	Carbone
D367,315	S	2/1996	Andrus
D367,333	S	2/1996	Swyst
D367,696	S	3/1996	Andrus
D367,934	S	3/1996	Carbone
D368,146	S	3/1996	Carbone
D368,317	S	3/1996	Swyst
5,499,767	A	3/1996	Morand
D368,539	S	4/1996	Carbone et al.
D368,540	S	4/1996	Santarsiero
D368,541	S	4/1996	Kaiser et al.
D368,542	S	4/1996	deBlois et al.
D369,204	S	4/1996	Andrus
D369,205	S	4/1996	Andrus
5,507,436	A	4/1996	Ruttenberg
D369,873	S	5/1996	deBlois et al.
D369,874	S	5/1996	Santarsiero
D369,875	S	5/1996	Carbone
D370,052	S	5/1996	Chan et al.
D370,250	S	5/1996	Fawcett et al.
D370,277	S	5/1996	Kaiser
D370,278	S	5/1996	Nolan
D370,279	S	5/1996	deBlois
D370,280	S	5/1996	Kaiser
D370,281	S	5/1996	Johnstone et al.
5,517,392	A	5/1996	Rousso et al.
5,521,803	A	5/1996	Eckert et al.
D370,542	S	6/1996	Santarsiero
D370,735	S	6/1996	deBlois
D370,987	S	6/1996	Santarsiero
D370,988	S	6/1996	Santarsiero
D371,448	S	7/1996	Santarsiero
D371,618	S	7/1996	Nolan
D371,619	S	7/1996	Szymanski
D371,856	S	7/1996	Carbone
D372,318	S	7/1996	Szymanski
D372,319	S	7/1996	Carbone
5,531,625	A	7/1996	Zhong
5,539,624	A	7/1996	Dougherty
D372,548	S	8/1996	Carbone
D372,998	S	8/1996	Carbone
D373,210	S	8/1996	Santarsiero
5,547,132	A	8/1996	Grogan
D373,434	S	9/1996	Nolan
D373,435	S	9/1996	Nolan
D373,645	S	9/1996	Johnstone et al.
D373,646	S	9/1996	Szymanski et al.
D373,647	S	9/1996	Kaiser
D373,648	S	9/1996	Kaiser
D373,649	S	9/1996	Carbone
D373,651	S	9/1996	Szymanski
D373,652	S	9/1996	Kaiser
5,551,637	A	9/1996	Lo
5,552,973	A	9/1996	Hsu
5,558,278	A	9/1996	Gallorini
D374,271	S	10/1996	Fleischmann
D374,297	S	10/1996	Kaiser
D374,298	S	10/1996	Swyst
D374,299	S	10/1996	Carbone
D374,493	S	10/1996	Szymanski
D374,494	S	10/1996	Santarsiero
D374,732	S	10/1996	Kaiser
D374,733	S	10/1996	Santasiero
5,560,548	A	10/1996	Mueller et al.
5,567,115	A	10/1996	Carbone
D375,541	S	11/1996	Michaluk
5,577,664	A	11/1996	Heitzman
D376,217	S	12/1996	Kaiser
D376,860	S	12/1996	Santarsiero
D376,861	S	12/1996	Johnstone et al.
D376,862	S	12/1996	Carbone
5,605,173	A	2/1997	Arnaud
D378,401	S	3/1997	Neufeld et al.
5,613,638	A	3/1997	Blessing
5,613,639	A	3/1997	Storm et al.
5,615,837	A	4/1997	Roman
5,624,074	A	4/1997	Parisi
5,624,498	A	4/1997	Lee et al.
D379,212	S	5/1997	Chan
D379,404	S	5/1997	Spelts
5,632,049	A	5/1997	Chen
D381,405	S	7/1997	Waidele et al.
D381,737	S	7/1997	Chan
D382,936	S	8/1997	Shfaram
5,653,260	A	8/1997	Huber
5,667,146	A	9/1997	Pimentel et al.
D385,332	S	10/1997	Andrus
D385,333	S	10/1997	Caroen et al.
D385,334	S	10/1997	Caroen et al.
D385,616	S	10/1997	Dow et al.
D385,947	S	11/1997	Dow et al.
D387,230	S	12/1997	von Buelow et al.
5,697,557	A	12/1997	Blessing et al.
5,699,964	A	12/1997	Bergmann et al.
5,702,057	A	12/1997	Huber
D389,558	S	1/1998	Andrus
5,704,080	A	1/1998	Kuhne
5,707,011	A	1/1998	Bosio
5,718,380	A	2/1998	Schorn et al.
D392,369	S	3/1998	Chan
5,730,361	A	3/1998	Thonnes
5,730,362	A	3/1998	Cordes
5,730,363	A	3/1998	Kress
5,742,961	A	4/1998	Casperson et al.
D394,490	S	5/1998	Andrus et al.
5,746,375	A	5/1998	Guo
5,749,552	A	5/1998	Fan
5,749,602	A	5/1998	Delaney et al.
D394,899	S	6/1998	Caroen et al.
D395,074	S	6/1998	Neibrook et al.
D395,075	S	6/1998	Kolada
D395,142	S	6/1998	Neibrook
5,764,760	A	6/1998	Grandbert et al.
5,765,760	A	6/1998	Kuo
5,769,802	A	6/1998	Wang
5,772,120	A	6/1998	Huber
5,778,939	A	7/1998	Hok-Yin
5,788,157	A	8/1998	Kress
D398,370	S	9/1998	Purdy
5,806,771	A	9/1998	Loschelder et al.
5,819,791	A	10/1998	Chronister et al.
5,820,574	A	10/1998	Henkin et al.
5,823,431	A	10/1998	Pierce
5,823,442	A	10/1998	Guo
5,826,803	A	10/1998	Cooper
5,833,138	A	11/1998	Crane et al.
5,839,666	A	11/1998	Heimann et al.
D402,350	S	12/1998	Andrus
D403,754	S	1/1999	Gottwald
D404,116	S	1/1999	Bosio
5,855,348	A	1/1999	Fornara
5,860,599	A	1/1999	Lin
5,862,543	A	1/1999	Reynoso et al.
5,862,985	A	1/1999	Neibrook et al.
D405,502	S	2/1999	Tse
5,865,375	A	2/1999	Hsu
5,865,378	A	2/1999	Hollinshead et al.
5,873,647	A	2/1999	Kurtz et al.
D408,893	S	4/1999	Tse
D409,276	S	5/1999	Ratzlaff
D410,276	S	5/1999	Ben-Tsur
5,918,809	A	7/1999	Simmons
5,918,811	A	7/1999	Denham et al.
D413,157	S	8/1999	Ratzlaff

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,937,905 A 8/1999 Santos
5,938,123 A 8/1999 Heitzman
5,941,462 A 8/1999 Sandor
5,947,388 A 9/1999 Woodruff
D415,247 S 10/1999 Haverstraw et al.
5,961,046 A 10/1999 Joubran
5,967,417 A 10/1999 Mantel
5,979,776 A 11/1999 Williams
5,992,762 A 11/1999 Wang
D418,200 S 12/1999 Ben-Tsur
5,997,047 A 12/1999 Pimentel et al.
6,003,165 A 12/1999 Loyd
D418,902 S 1/2000 Haverstraw et al.
D418,903 S 1/2000 Haverstraw et al.
D418,904 S 1/2000 Milrud
D421,099 S 2/2000 Mullenmeister
6,021,960 A 2/2000 Kehat
D422,053 S 3/2000 Brenner et al.
6,042,027 A 3/2000 Sandvik
6,042,155 A 3/2000 Lockwood
D422,336 S 4/2000 Haverstraw et al.
D422,337 S 4/2000 Chan
D423,083 S 4/2000 Haug et al.
D423,110 S 4/2000 Cipkowski
D424,160 S 5/2000 Haug et al.
D424,161 S 5/2000 Haug et al.
D424,162 S 5/2000 Haug et al.
D424,163 S 5/2000 Haug et al.
D426,290 S 6/2000 Haug et al.
D427,661 S 7/2000 Haverstraw et al.
D428,110 S 7/2000 Haug et al.
D428,125 S 7/2000 Chan
6,085,780 A 7/2000 Morris
D430,267 S 8/2000 Milrud et al.
6,095,801 A 8/2000 Spiewak
D430,643 S 9/2000 Tse
6,113,002 A 9/2000 Finkbeiner
6,123,272 A 9/2000 Havican et al.
6,123,308 A 9/2000 Faisst
D432,624 S 10/2000 Chan
D432,625 S 10/2000 Chan
D433,096 S 10/2000 Tse
D433,097 S 10/2000 Tse
6,126,091 A 10/2000 Heitzman
6,126,290 A 10/2000 Veigel
D434,109 S 11/2000 Ko
6,164,569 A 12/2000 Hollinshead et al.
6,164,570 A 12/2000 Smeltzer
D435,889 S 1/2001 Ben-Tsur et al.
D439,305 S 3/2001 Slothower
6,199,580 B1 3/2001 Morris
6,202,679 B1 3/2001 Titus
D440,276 S 4/2001 Slothower
D440,277 S 4/2001 Slothower
D440,278 S 4/2001 Slothower
D441,059 S 4/2001 Fleischmann
6,209,799 B1 4/2001 Finkbeiner
D443,025 S 5/2001 Kollmann et al.
D443,026 S 5/2001 Kollmann et al.
D443,027 S 5/2001 Kollmann et al.
D443,029 S 5/2001 Kollmann et al.
6,223,998 B1 5/2001 Heitzman
6,230,984 B1 5/2001 Jager
6,230,988 B1 5/2001 Chao et al.
6,230,989 B1 5/2001 Haverstraw et al.
D443,335 S 6/2001 Andrus
D443,336 S 6/2001 Kollmann et al.
D443,347 S 6/2001 Gottwald
6,241,166 B1 6/2001 Overington et al.
6,250,572 B1 6/2001 Chen
D444,865 S 7/2001 Gottwald
D445,871 S 7/2001 Fan
6,254,014 B1 7/2001 Clearman et al.
6,270,278 B1 8/2001 Mauro
6,276,004 B1 8/2001 Bertrand et al.
6,283,447 B1 9/2001 Fleet
6,286,764 B1 9/2001 Garvey et al.
D449,673 S 10/2001 Kollmann et al.
D450,370 S 11/2001 Wales et al.
D450,805 S 11/2001 Lindholm et al.
D450,806 S 11/2001 Lindholm et al.
D450,807 S 11/2001 Lindholm et al.
D451,169 S 11/2001 Lindholm et al.
D451,170 S 11/2001 Lindholm et al.
D451,171 S 11/2001 Lindholm et al.
D451,172 S 11/2001 Lindholm et al.
6,321,777 B1 11/2001 Wu
6,322,006 B1 11/2001 Guo
D451,583 S 12/2001 Lindholm et al.
D451,980 S 12/2001 Lindholm et al.
D452,553 S 12/2001 Lindholm et al.
D452,725 S 1/2002 Lindholm et al.
D452,897 S 1/2002 Gillette et al.
6,336,764 B1 1/2002 Liu
6,338,170 B1 1/2002 De Simone
D453,369 S 2/2002 Lobermeier
D453,370 S 2/2002 Lindholm et al.
D453,551 S 2/2002 Lindholm et al.
6,349,735 B2 2/2002 Gul
D454,617 S 3/2002 Curbbun et al.
D454,938 S 3/2002 Lord
6,375,342 B1 4/2002 Koren et al.
D457,937 S 5/2002 Lindholm et al.
6,382,531 B1 5/2002 Tracy
D458,348 S 6/2002 Mullenmeister
6,412,711 B1 7/2002 Fan
D461,224 S 8/2002 Lobermeier
D461,878 S 8/2002 Green et al.
6,450,425 B1 9/2002 Chen
6,454,186 B2 9/2002 Haverstraw et al.
6,463,658 B1 10/2002 Larsson
6,464,265 B1 10/2002 Mikol
D465,552 S 11/2002 Tse
D465,553 S 11/2002 Singtoroj
6,484,952 B2 11/2002 Koren
D468,800 S 1/2003 Tse
D469,165 S 1/2003 Lim
6,502,796 B1 1/2003 Wales
6,508,415 B2 1/2003 Wang
6,511,001 B1 1/2003 Huang
D470,219 S 2/2003 Schweitzer
6,516,070 B2 2/2003 Macey
D471,253 S 3/2003 Tse
D471,953 S 3/2003 Colligan et al.
6,533,194 B2 3/2003 Marsh et al.
6,537,455 B2 3/2003 Farley
D472,958 S 4/2003 Ouyoung
6,550,697 B2 4/2003 Lai
6,585,174 B1 7/2003 Huang
6,595,439 B1 7/2003 Chen
6,607,148 B1 8/2003 Marsh et al.
6,611,971 B1 9/2003 Antoniello et al.
6,637,676 B2 10/2003 Zieger et al.
6,641,057 B2 11/2003 Thomas et al.
D483,837 S 12/2003 Fan
6,659,117 B2 12/2003 Gilmore
6,659,372 B2 12/2003 Marsh et al.
D485,887 S 1/2004 Luettgen et al.
D486,888 S 2/2004 Lobermeier
6,691,338 B2 2/2004 Zieger
6,691,933 B1 2/2004 Bosio
D487,301 S 3/2004 Haug et al.
D487,498 S 3/2004 Blomstrom
6,701,953 B2 3/2004 Agosta
6,715,699 B1 4/2004 Greenberg et al.
6,719,218 B2 4/2004 Cool et al.
D489,798 S 5/2004 Hunt
D490,498 S 5/2004 Golichowski
6,736,336 B2 5/2004 Wong
6,739,523 B2 5/2004 Haverstraw et al.
6,739,527 B1 5/2004 Chung
D492,004 S 6/2004 Haug et al.
D492,007 S 6/2004 Kollmann et al.
6,742,725 B1 6/2004 Fan

(56) **References Cited**

U.S. PATENT DOCUMENTS

D493,208	S	7/2004	Lin
D493,864	S	8/2004	Haug et al.
D494,655	S	8/2004	Lin
D494,661	S	8/2004	Zieger et al.
D495,027	S	8/2004	Mazzola
6,776,357	B1	8/2004	Naito
6,789,751	B1	9/2004	Fan
D496,987	S	10/2004	Glunk
D497,974	S	11/2004	Haug et al.
D498,514	S	11/2004	Haug et al.
D500,121	S	12/2004	Blomstrom
D500,549	S	1/2005	Blomstrom
D501,242	S	1/2005	Blomstrom
D502,760	S	3/2005	Zieger et al.
D502,761	S	3/2005	Zieger et al.
D503,211	S	3/2005	Lin
6,863,227	B2	3/2005	Wollenberg et al.
6,869,030	B2	3/2005	Blessing et al.
D503,774	S	4/2005	Zieger
D503,775	S	4/2005	Zieger
D503,966	S	4/2005	Zieger
6,899,292	B2	5/2005	Titinet
D506,243	S	6/2005	Wu
D507,037	S	7/2005	Wu
6,935,581	B2	8/2005	Titinet
D509,280	S	9/2005	Bailey et al.
D509,563	S	9/2005	Bailey et al.
D510,123	S	9/2005	Tsai
D511,809	S	11/2005	Haug et al.
D512,119	S	11/2005	Haug et al.
6,981,661	B1	1/2006	Chen
D516,169	S	2/2006	Wu
7,000,854	B2	2/2006	Malek et al.
7,004,409	B2	2/2006	Okubo
7,004,410	B2	2/2006	Li
D520,109	S	5/2006	Wu
7,040,554	B2	5/2006	Drennow
7,048,210	B2	5/2006	Clark
7,055,767	B1	6/2006	Ko
7,070,125	B2	7/2006	Williams et al.
7,077,342	B2	7/2006	Lee
D527,440	S	8/2006	Macan
7,093,780	B1	8/2006	Chung
7,097,122	B1	8/2006	Farley
D528,631	S	9/2006	Gillette et al.
7,100,845	B1	9/2006	Hsieh
7,111,795	B2	9/2006	Thong
7,111,798	B2	9/2006	Thomas et al.
D530,389	S	10/2006	Glenslak et al.
D530,392	S	10/2006	Tse
D531,259	S	10/2006	Hsieh
7,114,666	B2	10/2006	Luettgen et al.
D533,253	S	12/2006	Luettgen et al.
D534,239	S	12/2006	Dingler et al.
D535,354	S	1/2007	Wu
D536,060	S	1/2007	Sadler
7,156,325	B1	1/2007	Chen
D538,391	S	3/2007	Mazzola
D540,424	S	4/2007	Kirar
D540,425	S	4/2007	Endo et al.
D540,426	S	4/2007	Cropelli
D540,427	S	4/2007	Bouroullec et al.
D542,391	S	5/2007	Gilbert
D542,393	S	5/2007	Haug et al.
D544,573	S	6/2007	Dingler et al.
7,229,031	B2	6/2007	Schmidt
7,243,863	B2	7/2007	Glunk
7,246,760	B2	7/2007	Marty et al.
D552,713	S	10/2007	Rexach
7,278,591	B2	10/2007	Clearman et al.
D556,295	S	11/2007	Genord et al.
7,299,510	B2	11/2007	Tsai
D557,763	S	12/2007	Schonherr et al.
D557,764	S	12/2007	Schonherr et al.
D557,765	S	12/2007	Schonherr et al.
D558,301	S	12/2007	Hoernig
7,303,151	B2	12/2007	Wu
D559,357	S	1/2008	Wang et al.
D559,945	S	1/2008	Patterson et al.
D560,269	S	1/2008	Tse
D562,937	S	2/2008	Schonherr et al.
D562,938	S	2/2008	Blessing
D562,941	S	2/2008	Pan
7,331,536	B1	2/2008	Zhen et al.
7,347,388	B2	3/2008	Chung
D565,699	S	4/2008	Berberet
D565,702	S	4/2008	Daunter et al.
D565,703	S	4/2008	Lammel et al.
D566,228	S	4/2008	Neagoe
D566,229	S	4/2008	Rexach
D567,328	S	4/2008	Spangler et al.
D567,335	S	4/2008	Huang
7,360,723	B2	4/2008	Lev
7,364,097	B2	4/2008	Okuma
7,374,112	B1	5/2008	Bulan et al.
7,384,007	B2	6/2008	Ho
D577,099	S	9/2008	Leber
D577,793	S	9/2008	Leber
D578,604	S	10/2008	Wu et al.
D578,605	S	10/2008	Wu et al.
D578,608	S	10/2008	Wu et al.
D580,012	S	11/2008	Quinn et al.
D580,513	S	11/2008	Quinn et al.
D581,013	S	11/2008	Citterio
D581,014	S	11/2008	Quinn et al.
D586,426	S	2/2009	Schoenherr et al.
7,503,345	B2	3/2009	Paterson et al.
D590,048	S	4/2009	Leber et al.
7,520,448	B2	4/2009	Luettgen et al.
D592,276	S	5/2009	Shoenherr et al.
D592,278	S	5/2009	Leber
7,533,906	B2	5/2009	Luettgen et al.
7,537,175	B2	5/2009	Miura et al.
D600,777	S	9/2009	Whitaker et al.
D603,935	S	11/2009	Leber
7,617,990	B2	11/2009	Huffman
D605,731	S	12/2009	Leber
D606,623	S	12/2009	Whitaker et al.
D608,412	S	1/2010	Barnard et al.
D608,413	S	1/2010	Barnard et al.
D616,061	S	5/2010	Whitaker et al.
7,721,979	B2	5/2010	Mazzola
7,740,186	B2	6/2010	Macan et al.
D621,904	S	8/2010	Yoo et al.
D621,905	S	8/2010	Yoo et al.
7,770,820	B2	8/2010	Clearman et al.
7,770,822	B2	8/2010	Leber
D624,156	S	9/2010	Leber
7,789,326	B2	9/2010	Luettgen et al.
D625,776	S	10/2010	Williams
7,832,662	B2	11/2010	Gallo
D628,676	S	12/2010	Lee
D629,867	S	12/2010	Rexach et al.
7,871,020	B2	1/2011	Nelson et al.
D641,831	S	7/2011	Williams
8,020,787	B2	9/2011	Leber et al.
8,020,788	B2	9/2011	Luettgen et al.
8,024,822	B2	9/2011	Macan et al.
8,028,935	B2	10/2011	Leber
D652,114	S	1/2012	Yoo
8,109,450	B2	2/2012	Luettgen et al.
D656,582	S	3/2012	Flowers et al.
8,132,745	B2	3/2012	Leber et al.
8,146,838	B2	4/2012	Luettgen et al.
8,220,726	B2	7/2012	Qiu et al.
D667,531	S	9/2012	Romero et al.
D669,158	S	10/2012	Flowers et al.
8,292,200	B2	10/2012	Macan et al.
8,297,534	B2	10/2012	Li et al.
D672,433	S	12/2012	Yoo et al.
D673,649	S	1/2013	Quinn et al.
D674,047	S	1/2013	Yoo et al.
D674,050	S	1/2013	Quinn et al.
8,348,181	B2	1/2013	Whitaker

(56) **References Cited**

U.S. PATENT DOCUMENTS

8,366,024 B2	2/2013	Leber	
D678,463 S	3/2013	Quinn et al.	
D678,467 S	3/2013	Quinn et al.	
8,794,543 B2 *	8/2014	Leber	B05B 3/04 239/381
2006/0272086 A1	12/2006	Mesa	
2007/0040054 A1	2/2007	Farzan	
2007/0200013 A1	8/2007	Hsiao	
2007/0246577 A1 *	10/2007	Leber	B05B 1/18 239/589
2007/0252021 A1	11/2007	Cristina	
2007/0272770 A1	11/2007	Leber et al.	
2008/0073449 A1	3/2008	Haynes et al.	
2008/0083844 A1	4/2008	Leber et al.	
2008/0121293 A1	5/2008	Leber et al.	
2008/0156897 A1	7/2008	Leber	
2008/0223957 A1	9/2008	Schorn	
2008/0272591 A1	11/2008	Leber	
2009/0200404 A1	8/2009	Cristina	
2009/0218420 A1	9/2009	Mazzola	
2009/0307836 A1	12/2009	Blattner et al.	
2010/0127096 A1	5/2010	Leber	
2011/0000983 A1	1/2011	Chang	
2011/0011953 A1	1/2011	Macan et al.	
2011/0121098 A1	5/2011	Luettgen et al.	
2012/0048968 A1	3/2012	Williams	
2013/0126646 A1	5/2013	Wu	
2013/0147186 A1	6/2013	Leber	

FOREIGN PATENT DOCUMENTS

CH	234284	3/1963
DE	352813	5/1922
DE	848627	9/1952
DE	854100	10/1952
DE	2360534	6/1974
DE	2806093	8/1979
DE	3107808	9/1982
DE	3246327	6/1984
DE	3440901	7/1985
DE	3706320	3/1988
DE	8804236	6/1988
DE	4034695	5/1991
DE	19608085	9/1996
DE	202005000881	3/2005
DE	102006032017	1/2008
EP	0167063	6/1985
EP	0478999	4/1992
EP	0514753	11/1992
EP	0435030	7/1993
EP	0617644	10/1994
EP	0683354	11/1995
EP	0687851	12/1995
EP	0695907	2/1996
EP	0700729	3/1996
EP	0719588	7/1996
EP	0721082	7/1996
EP	0733747	9/1996
EP	0808661	11/1997
EP	0726811	1/1998
EP	2164642	10/2010
EP	2260945	12/2010
FR	538538	6/1922
FR	873808	7/1942
FR	1039750	10/1953
FR	1098836	8/1955
FR	2596492	10/1987
FR	2695452	3/1994
GB	3314	0/1914
GB	10086	0/1894
GB	129812	7/1919
GB	204600	10/1923
GB	634483	3/1950
GB	971866	10/1964
GB	1111126	4/1968
GB	2066074	1/1980
GB	2066704	7/1981
GB	2068778	8/1981
GB	2121319	12/1983
GB	2155984	10/1985
GB	2156932 A	10/1985
GB	2199771	7/1988
GB	2298595	11/1996
GB	2337471	11/1999
IT	327400	7/1935
IT	350359	7/1937
IT	563459	5/1957
JP	S63-181459	11/1988
JP	H2-78660	6/1990
JP	4062238	2/1992
JP	4146708	5/1992
NL	8902957	6/1991
WO	WO93/12894	7/1993
WO	WO93/25839	12/1993
WO	WO96/00617	1/1996
WO	WO98/30336	7/1998
WO	WO99/59726	11/1999
WO	WO00/10720	3/2000
WO	WO2010/004593	1/2010

OTHER PUBLICATIONS

Color Copy, Labeled 1A, Gemlo, available at least as early as Dec. 2, 1998.

Color Copy, Labeled 1B, Gemlo, available at least as early as Dec. 2, 1998.

* cited by examiner

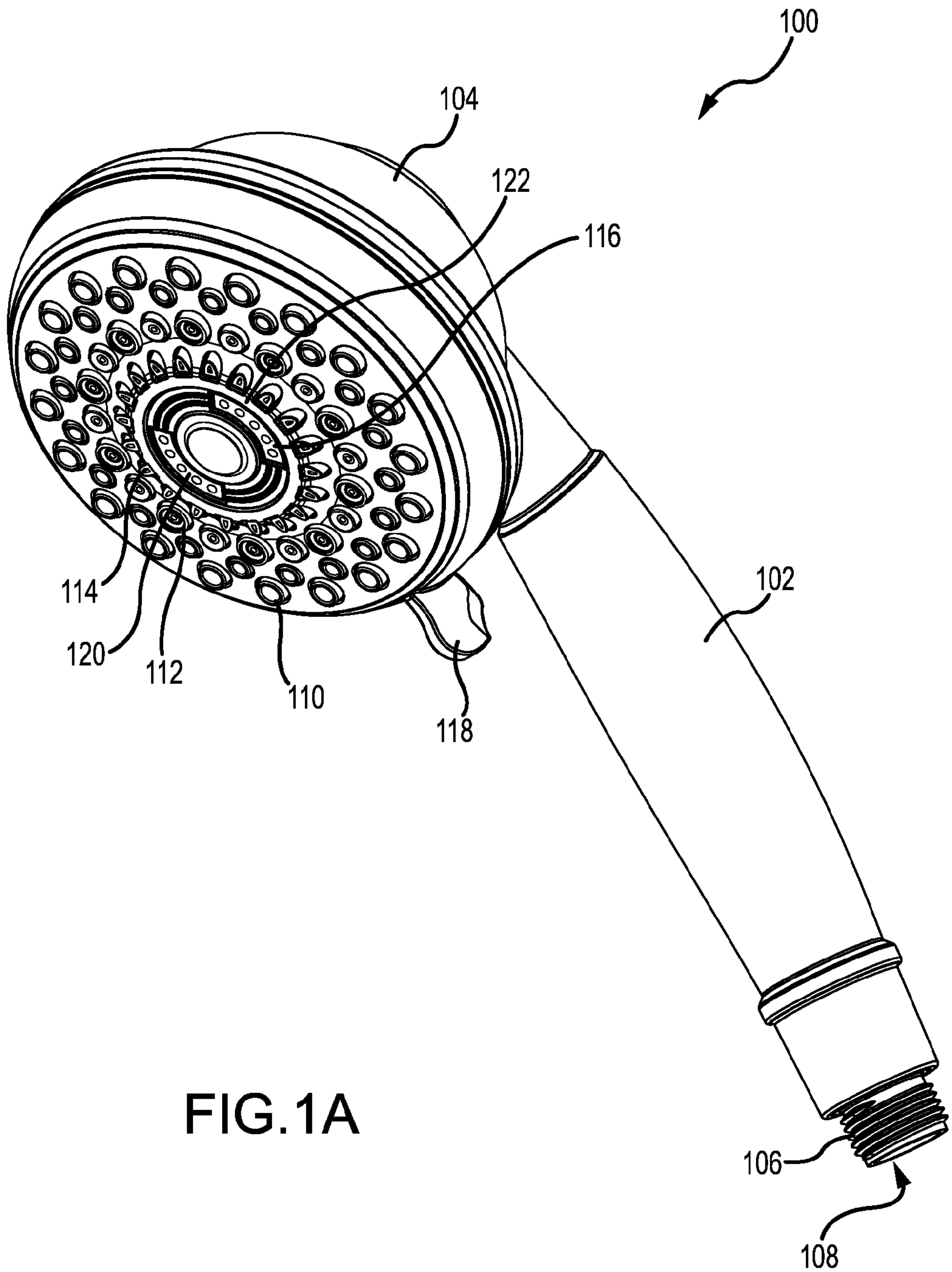


FIG.1A

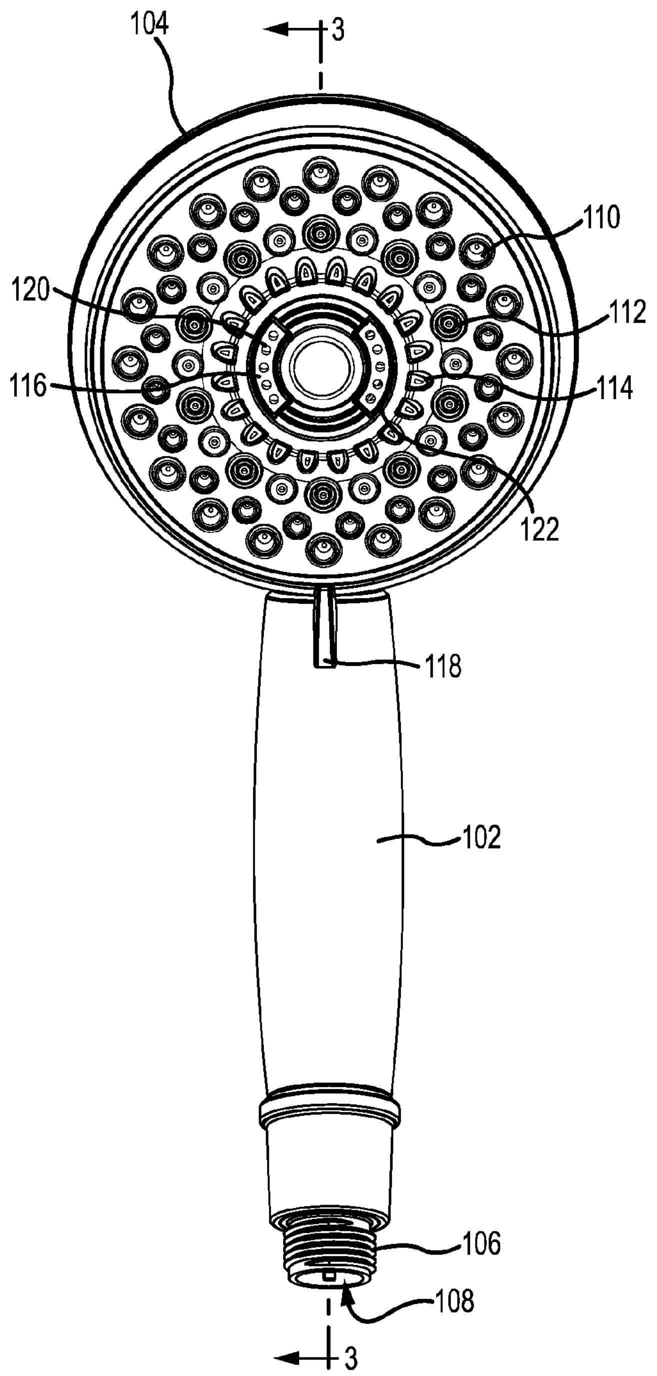


FIG.1B

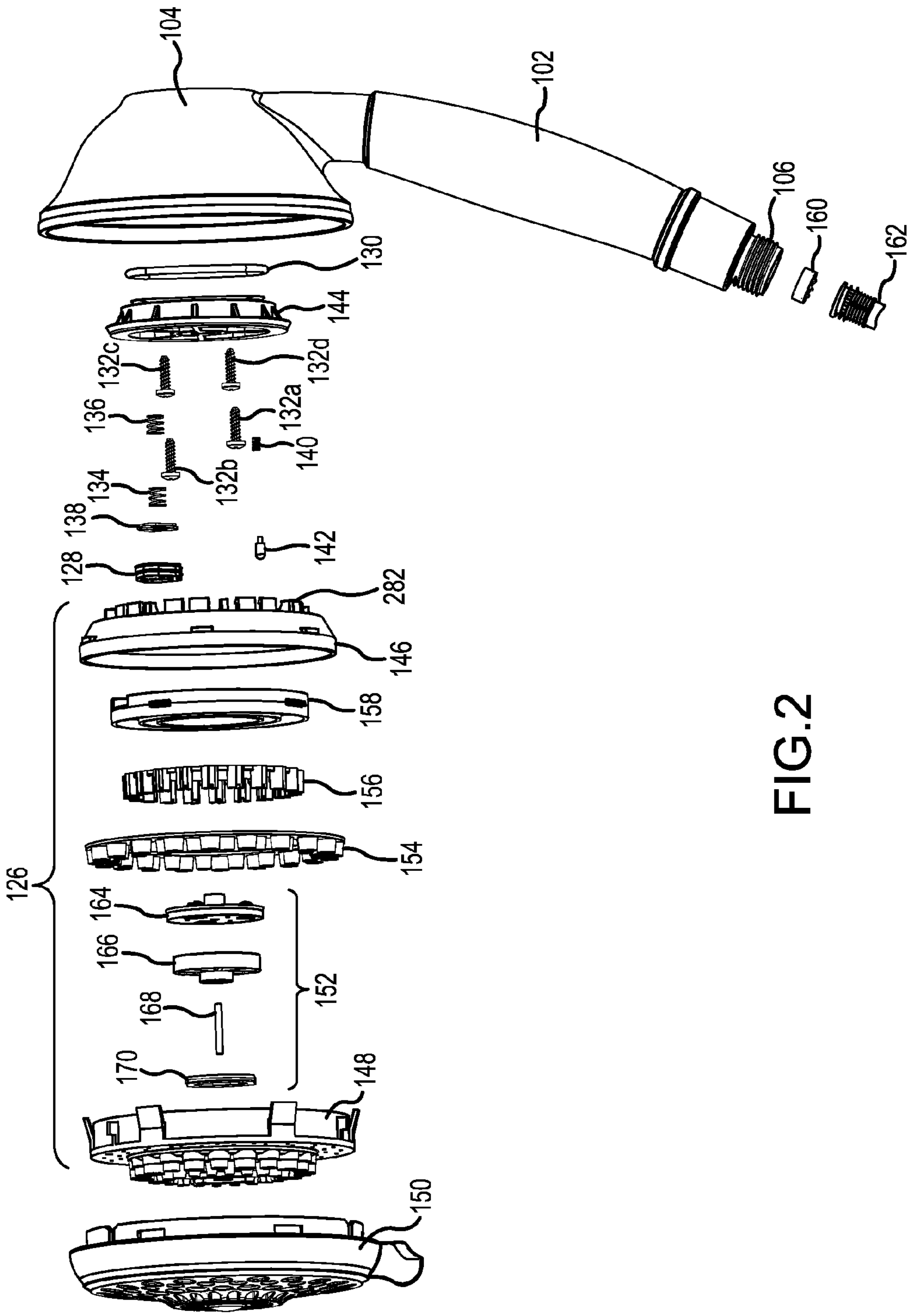

104
102
106
160
162
130
144
132c
132d
136
132a
140
132b
134
138
142
128
282
146
126
158
156
154
164
166
152
168
170
148
150

FIG.2

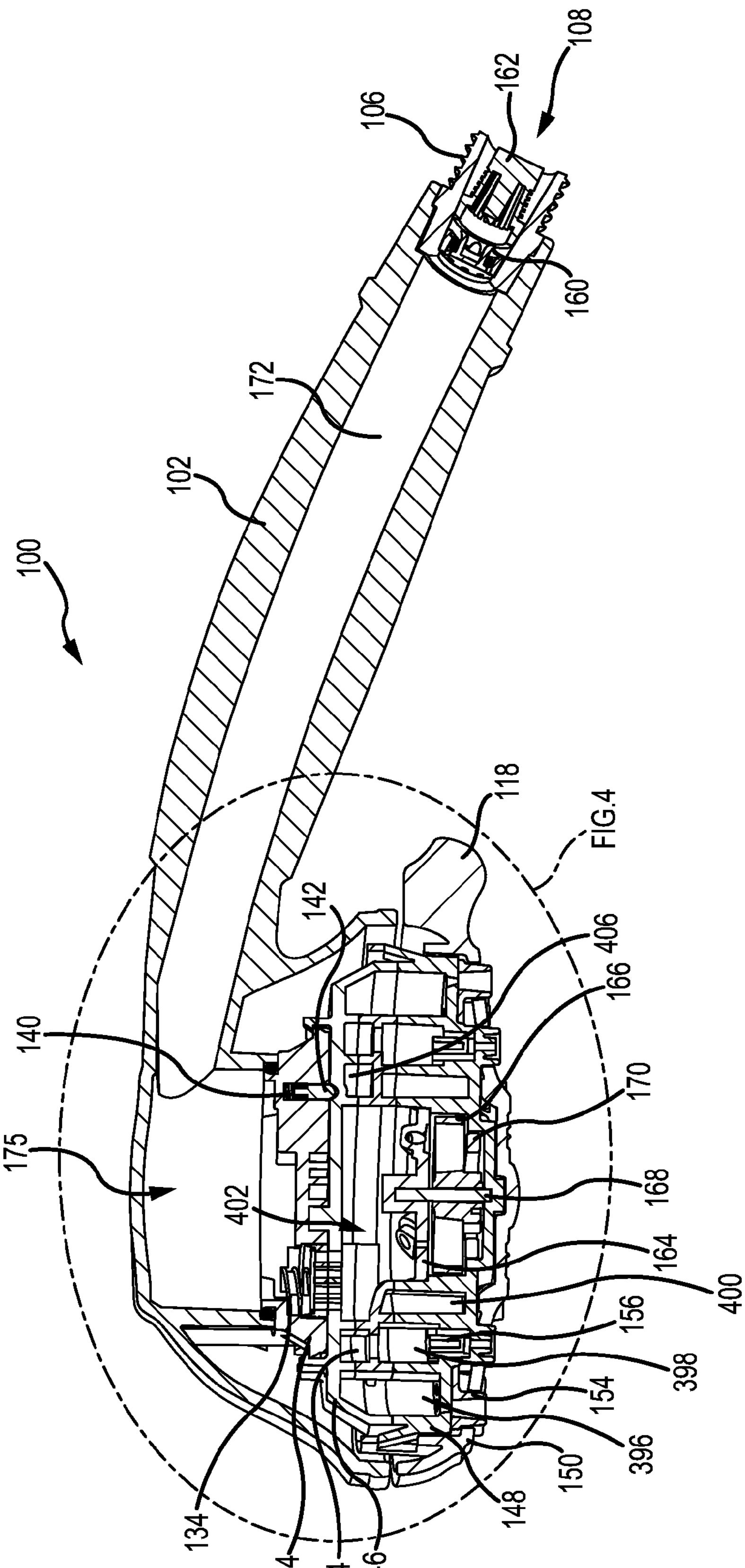

108
162
106
160
172
102
100
118
FIG.4
142
406
166
140
170
175
168
402
164
400
156
398
154
396
150
148
134
144
404
146

FIG.3

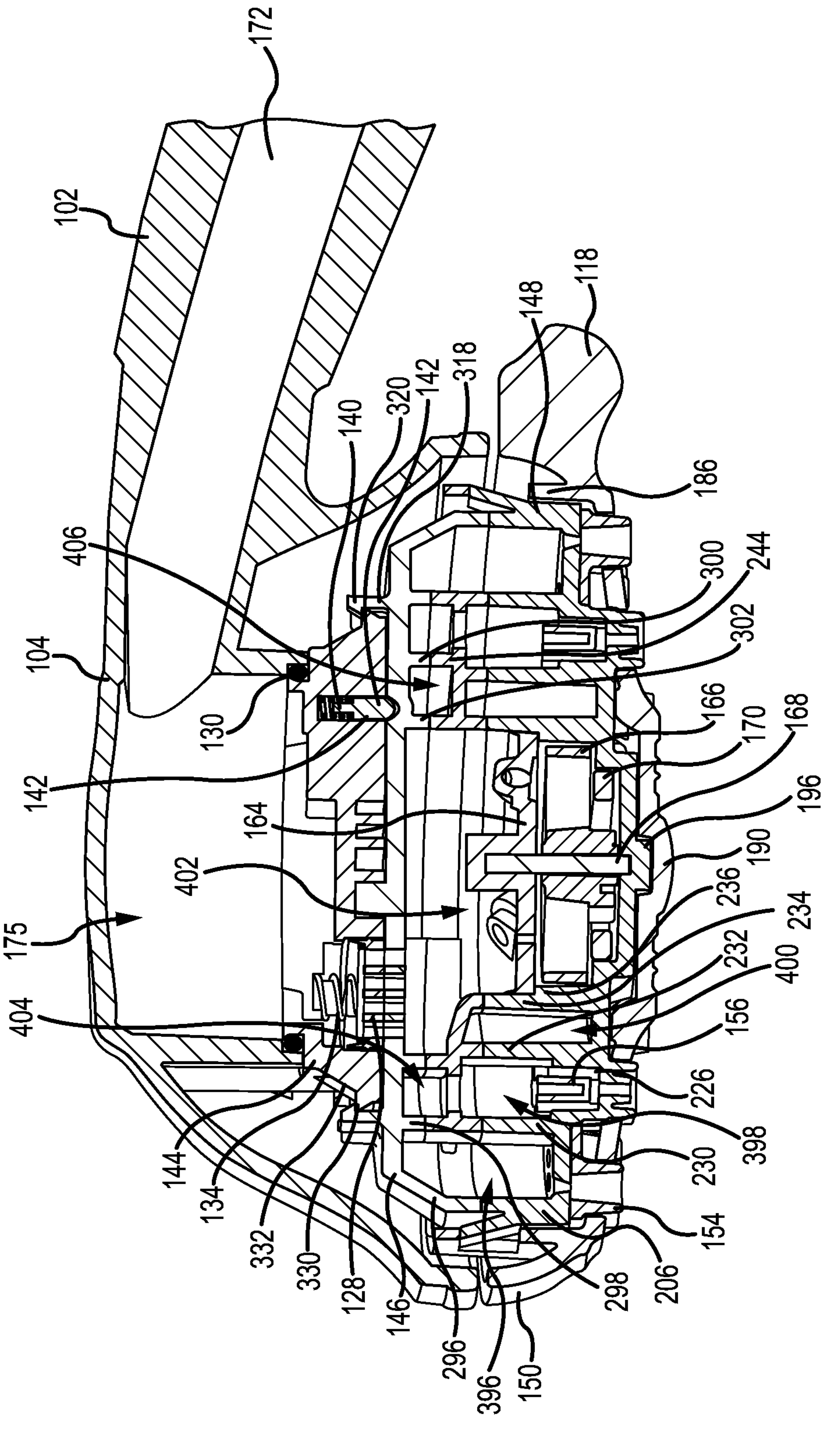

172
102
118
148
104
406
140
320
142
318
186
300
244
302
130
142
166
170
168
196
164
190
402
236
234
175
232
400
404
156
226
144
134
332
330
128
146
296
396
150
298
206
154
230
398

FIG.4

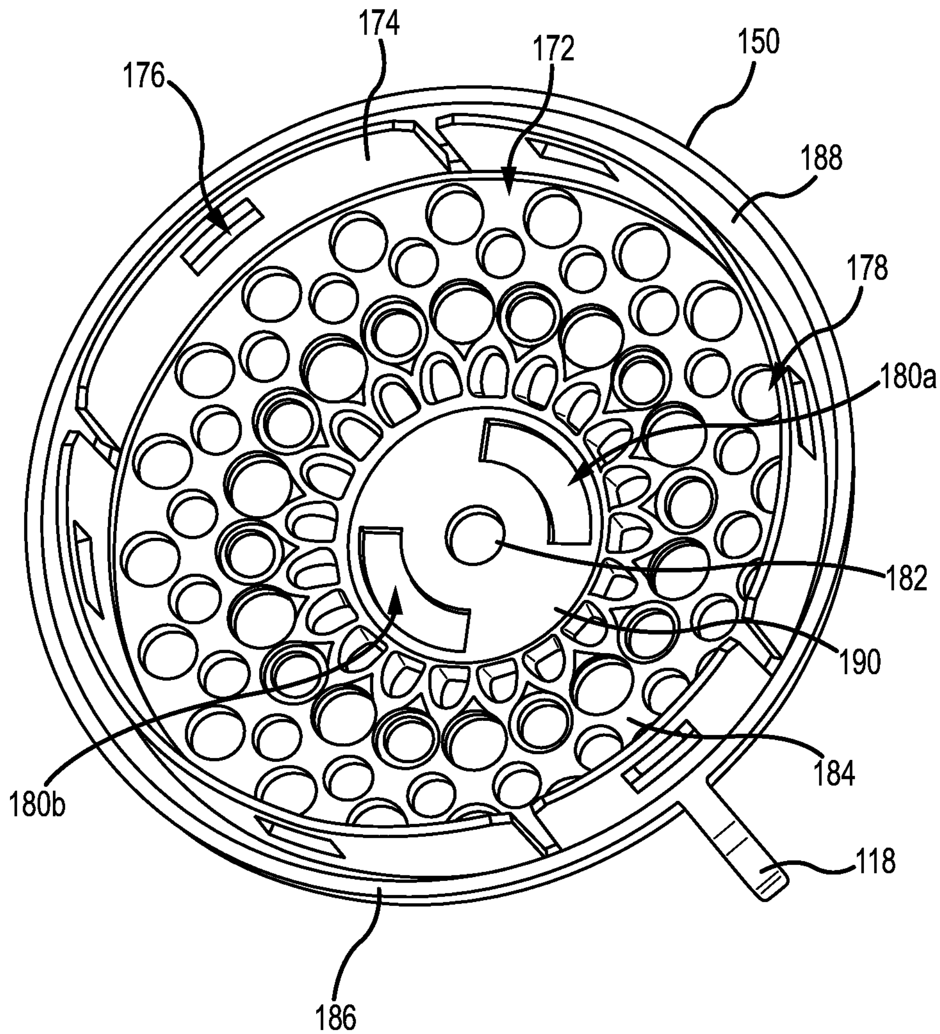
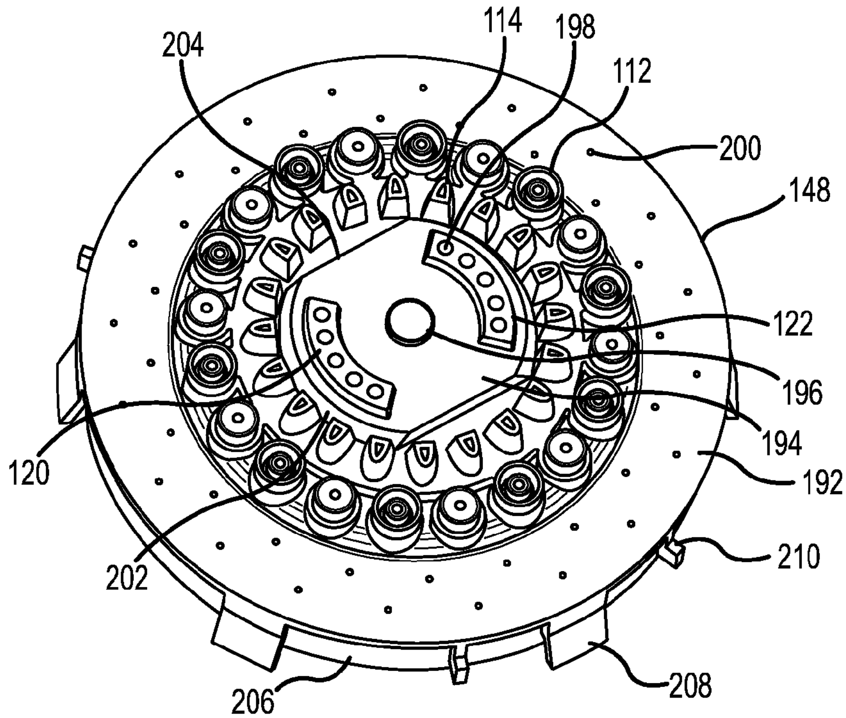


FIG.5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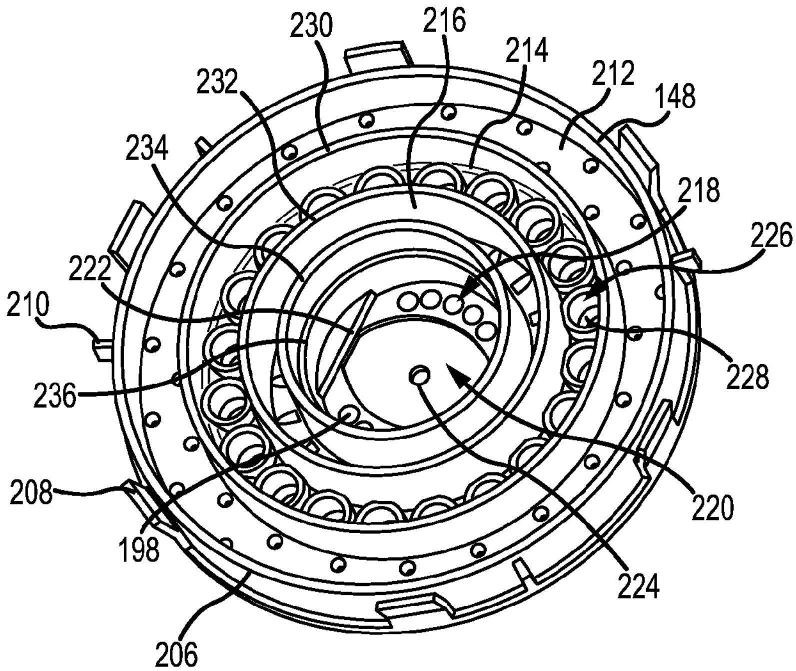
204
112
200
148
122
196
194
120
192
202
210
206
208

FIG.6A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216
214
232
212
148
234
218
226
222
210
228
236
208
220
198
224
206

FIG.6B

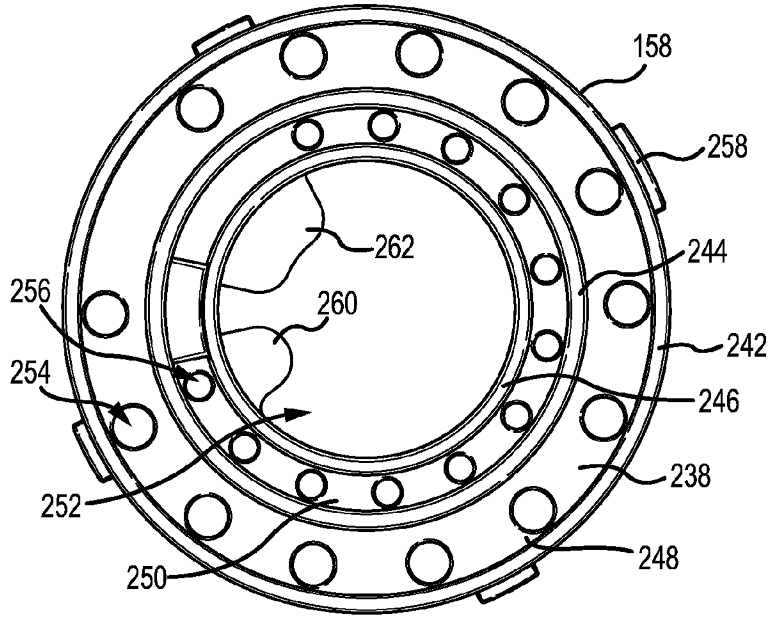
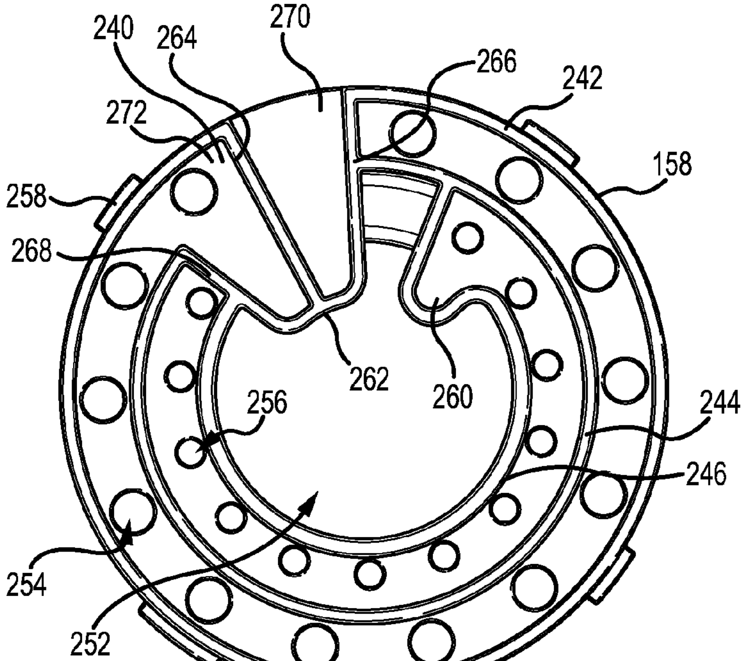

158
258
262
244
256
260
242
254
246
238
252
248
250

FIG.7A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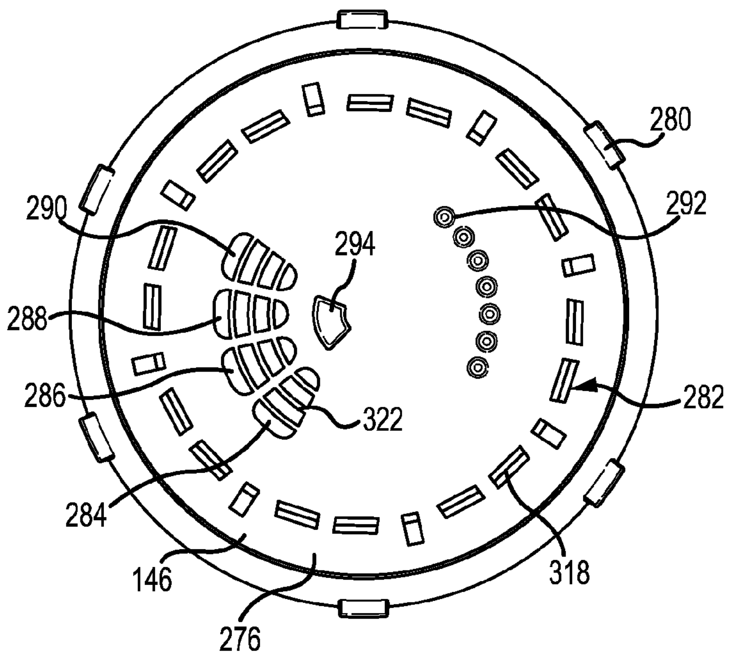
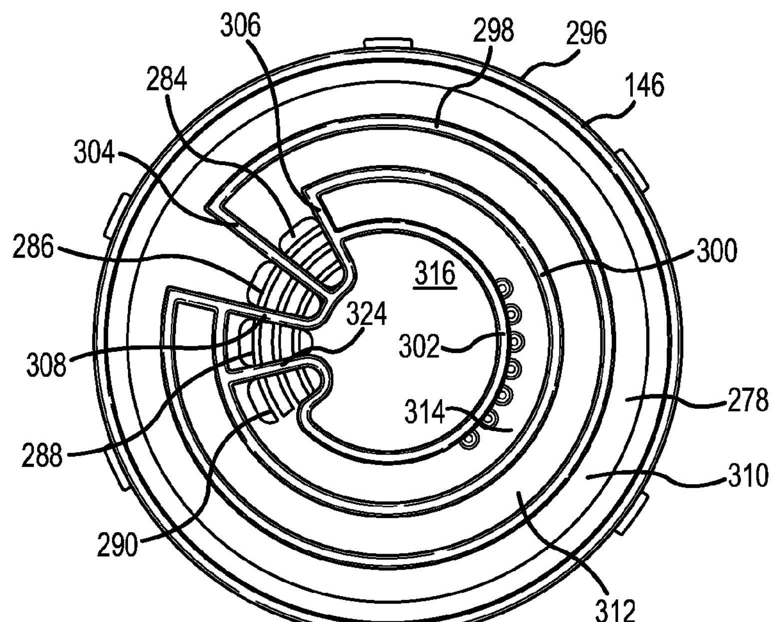
264
266
242
272
158
258
268
262
260
256
244
246
254
252

FIG.7B



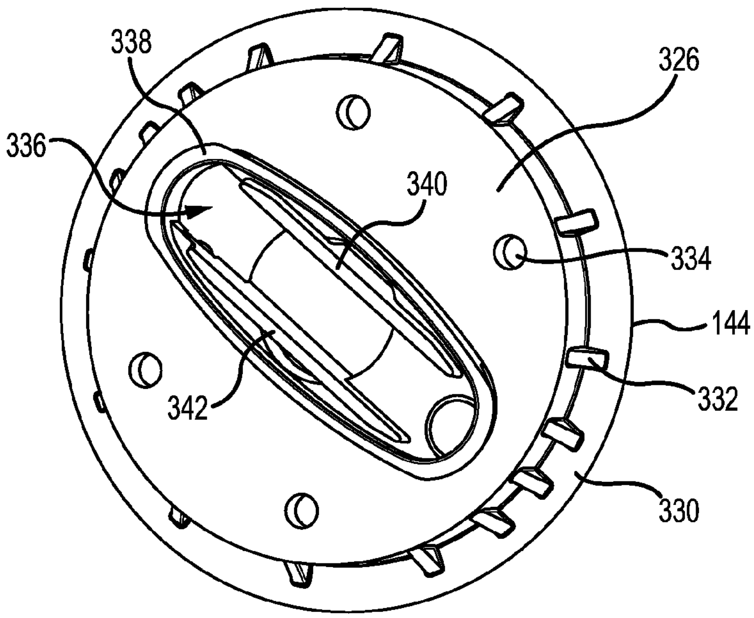
280
290
292
294
288
286
282
322
284
318
146
276

FIG.8A



306
298
296
284
146
304
286
300
316
324
302
308
278
314
288
310
290
312

FIG.8B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144
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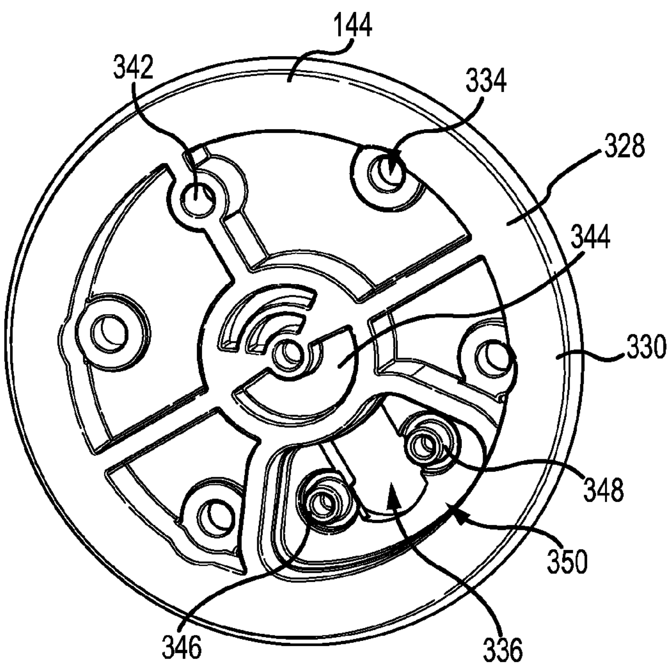
330

FIG.9A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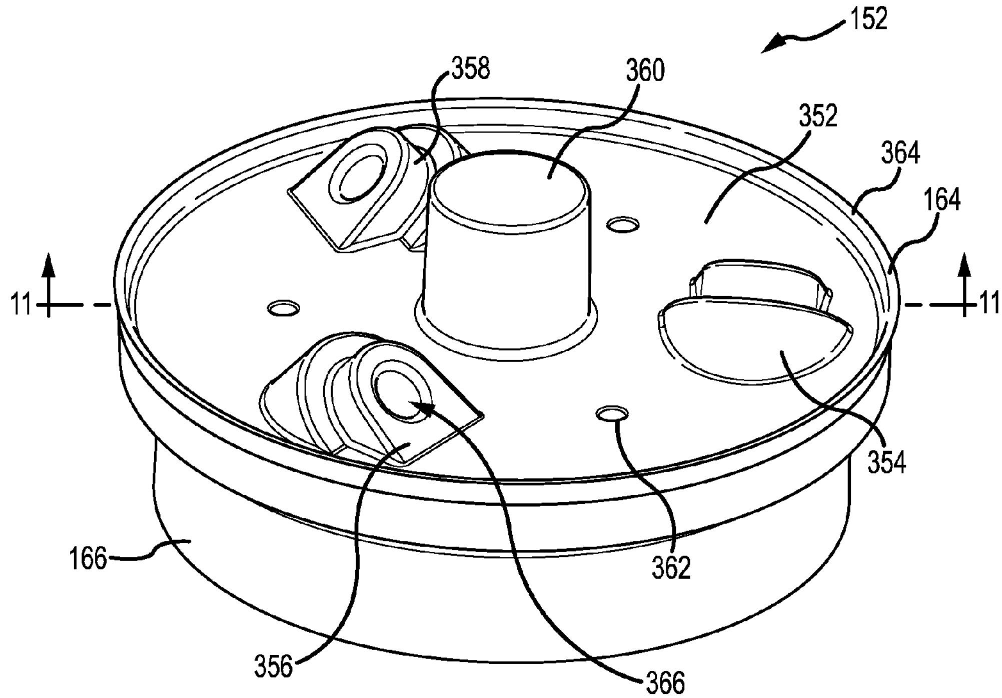
336

FIG.9B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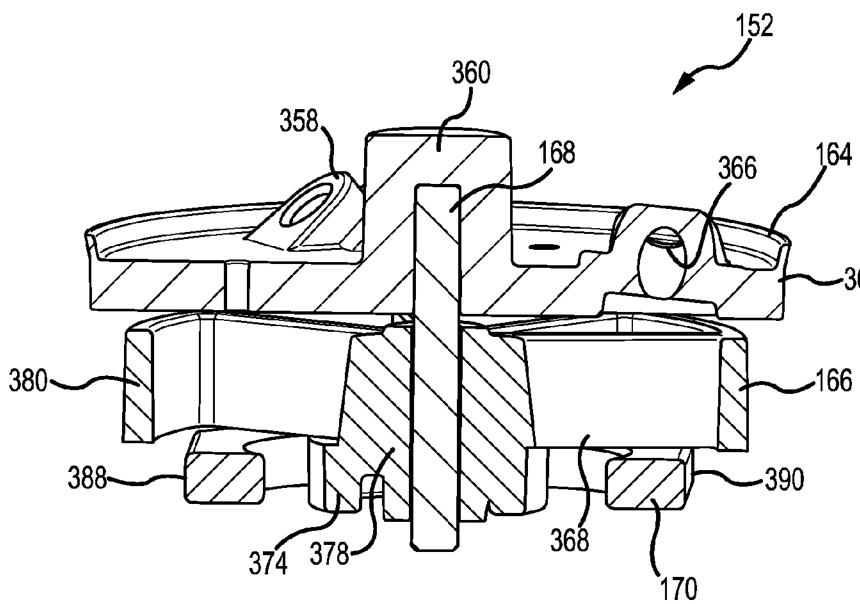
358
360
352
364
164
11
11
166
356
366
362
354

FIG.10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360
358
168
366
164
364
380
166
388
390
374
378
368
170

FIG.11

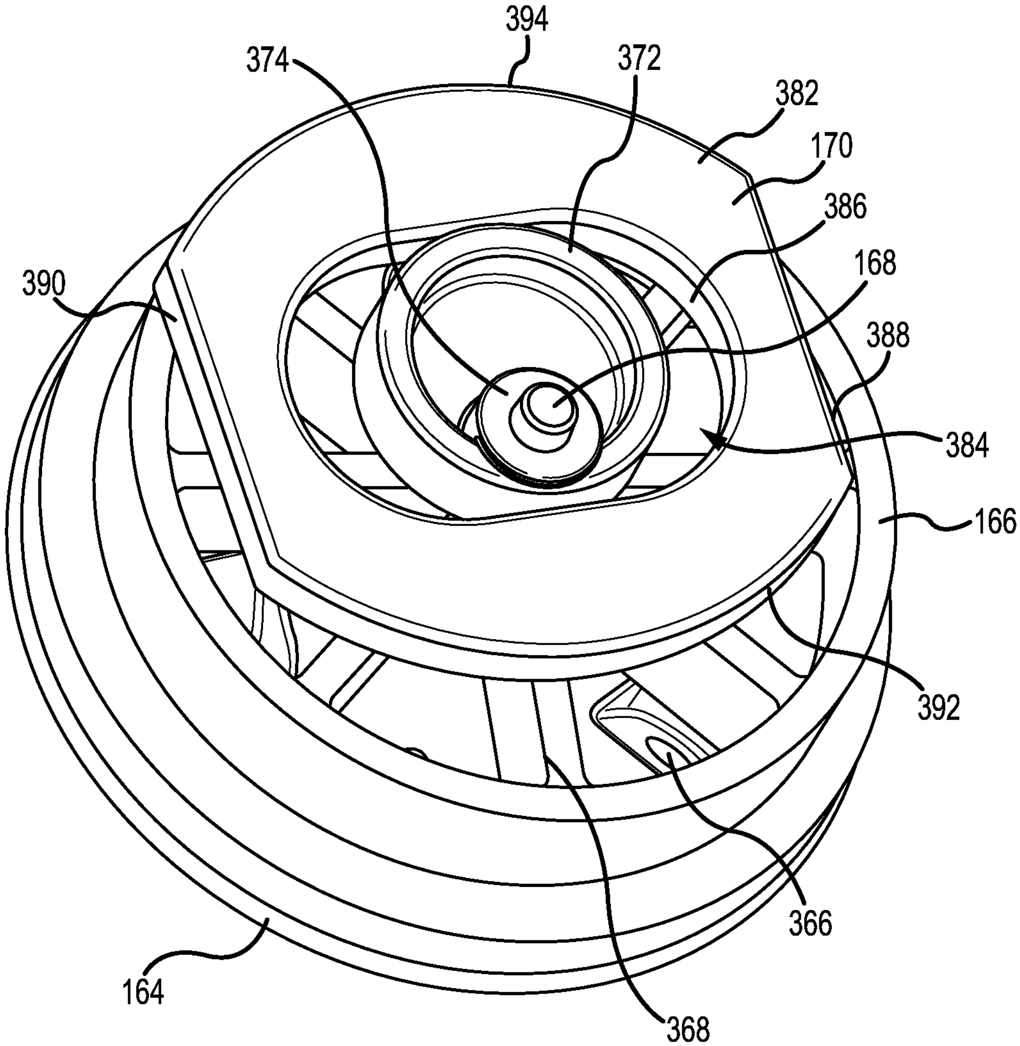


FIG.12

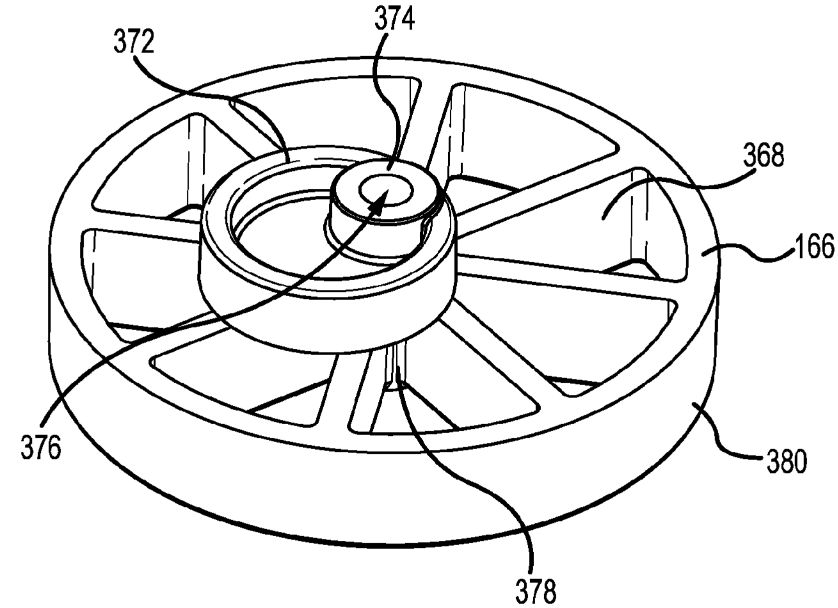


FIG.13A

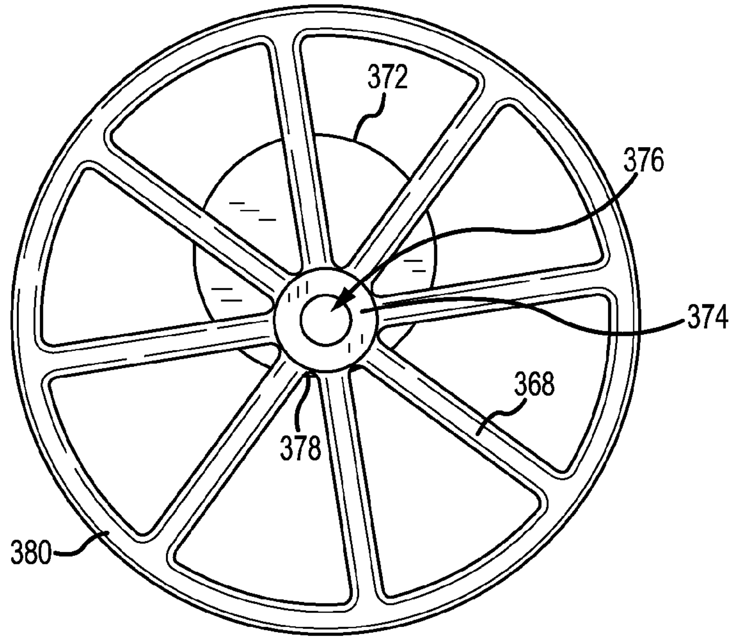
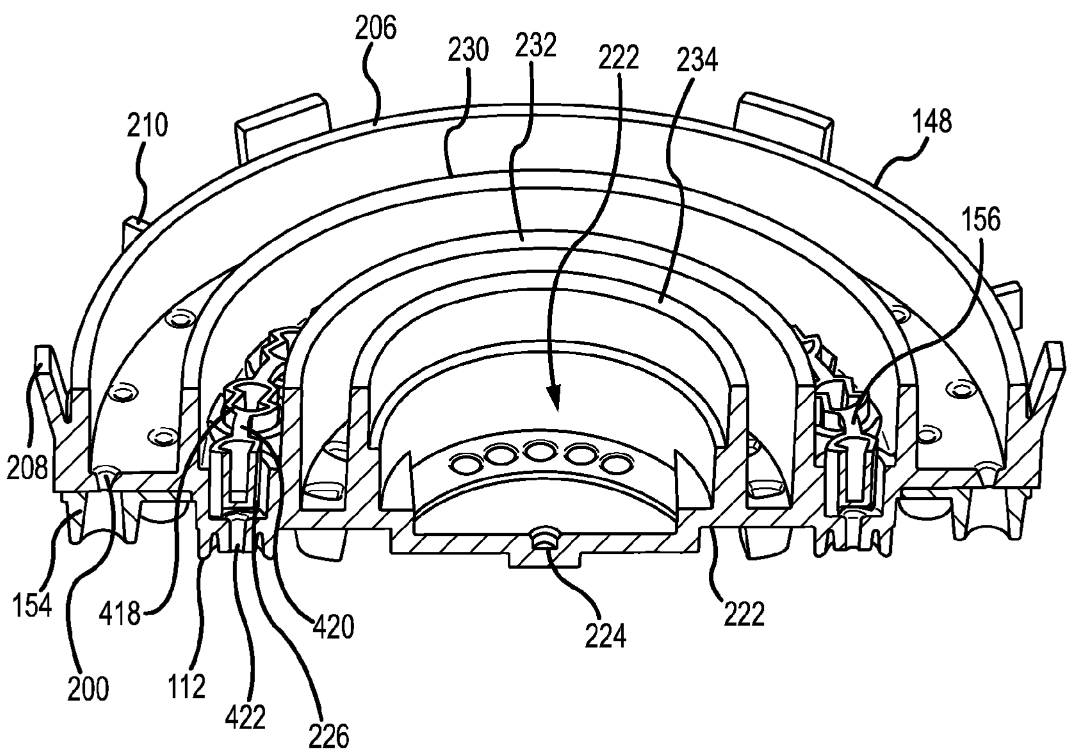


FIG.13B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156
208
154
418
200
112
422
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420
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FIG.14

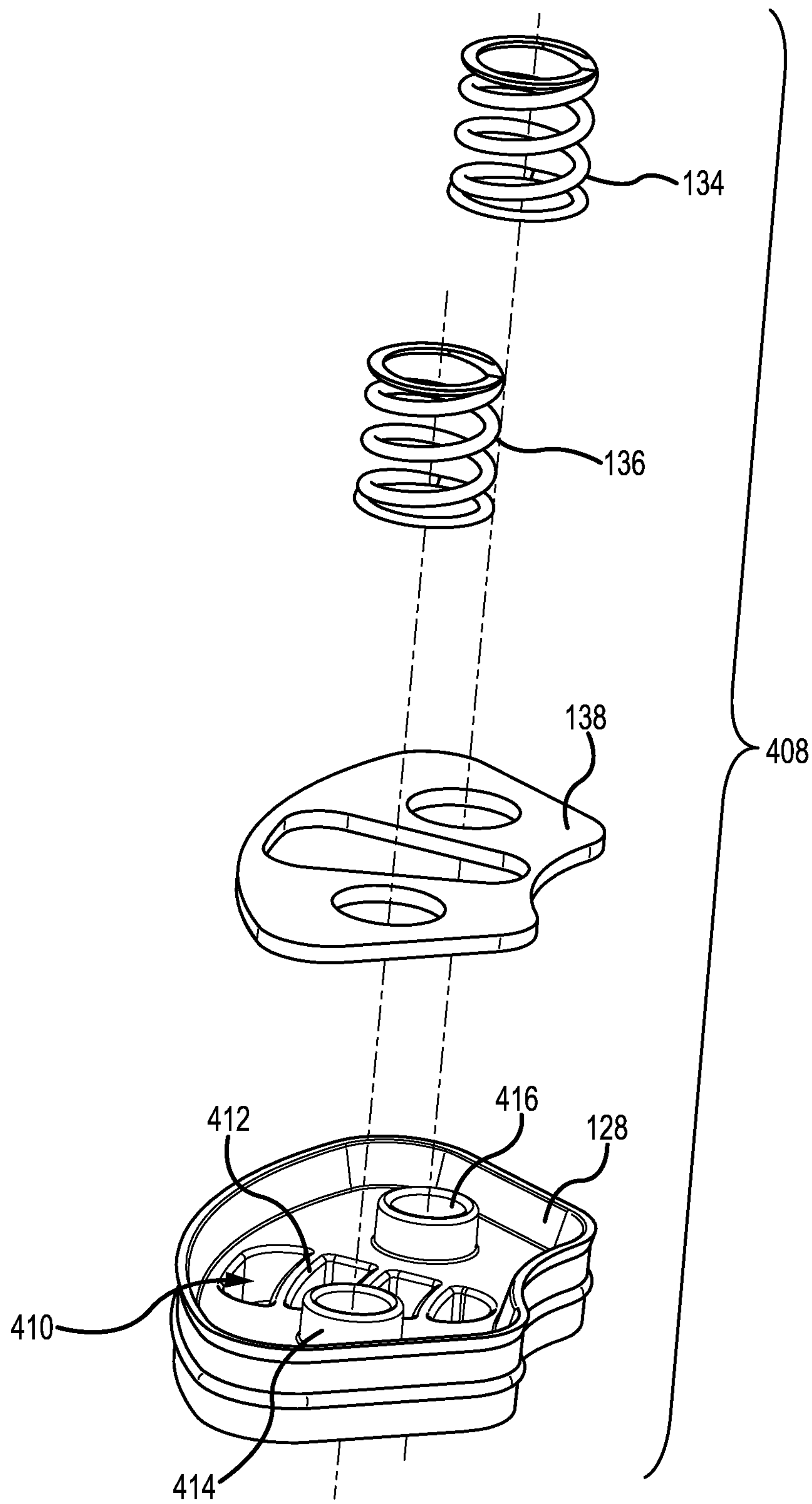


FIG.15

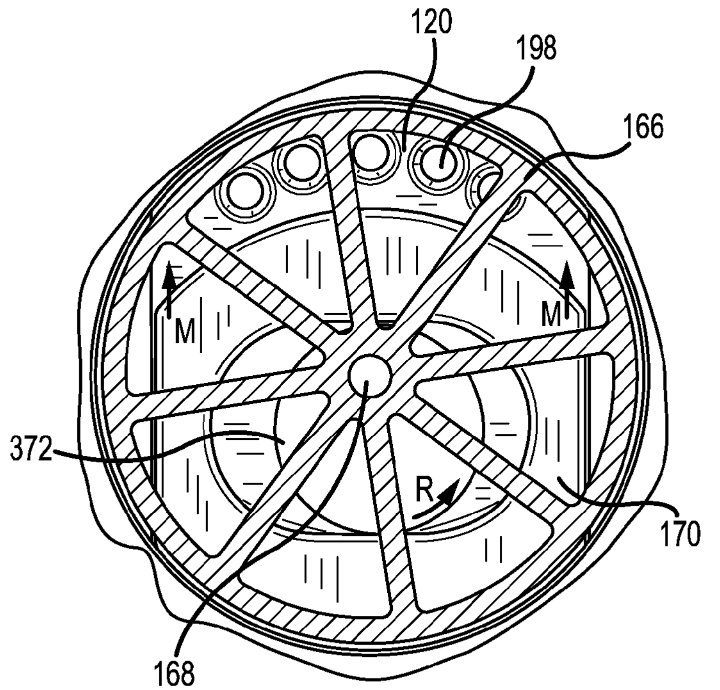


FIG.16A

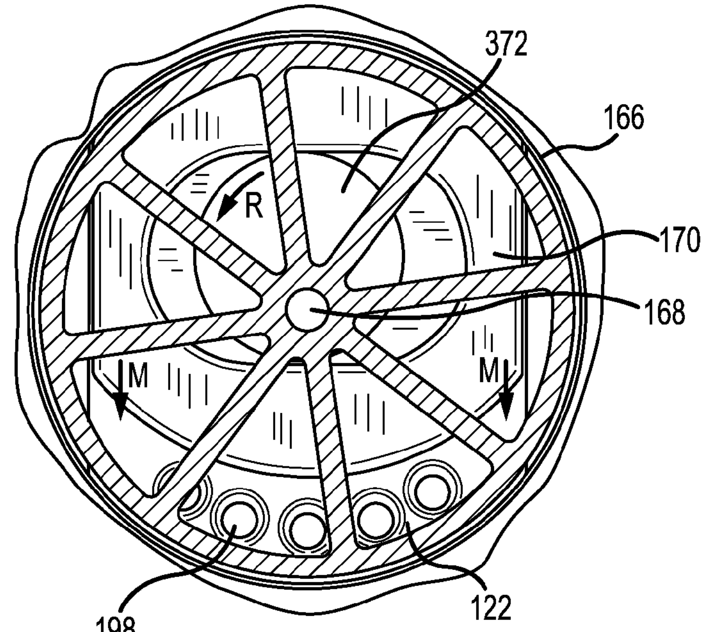


FIG.16B

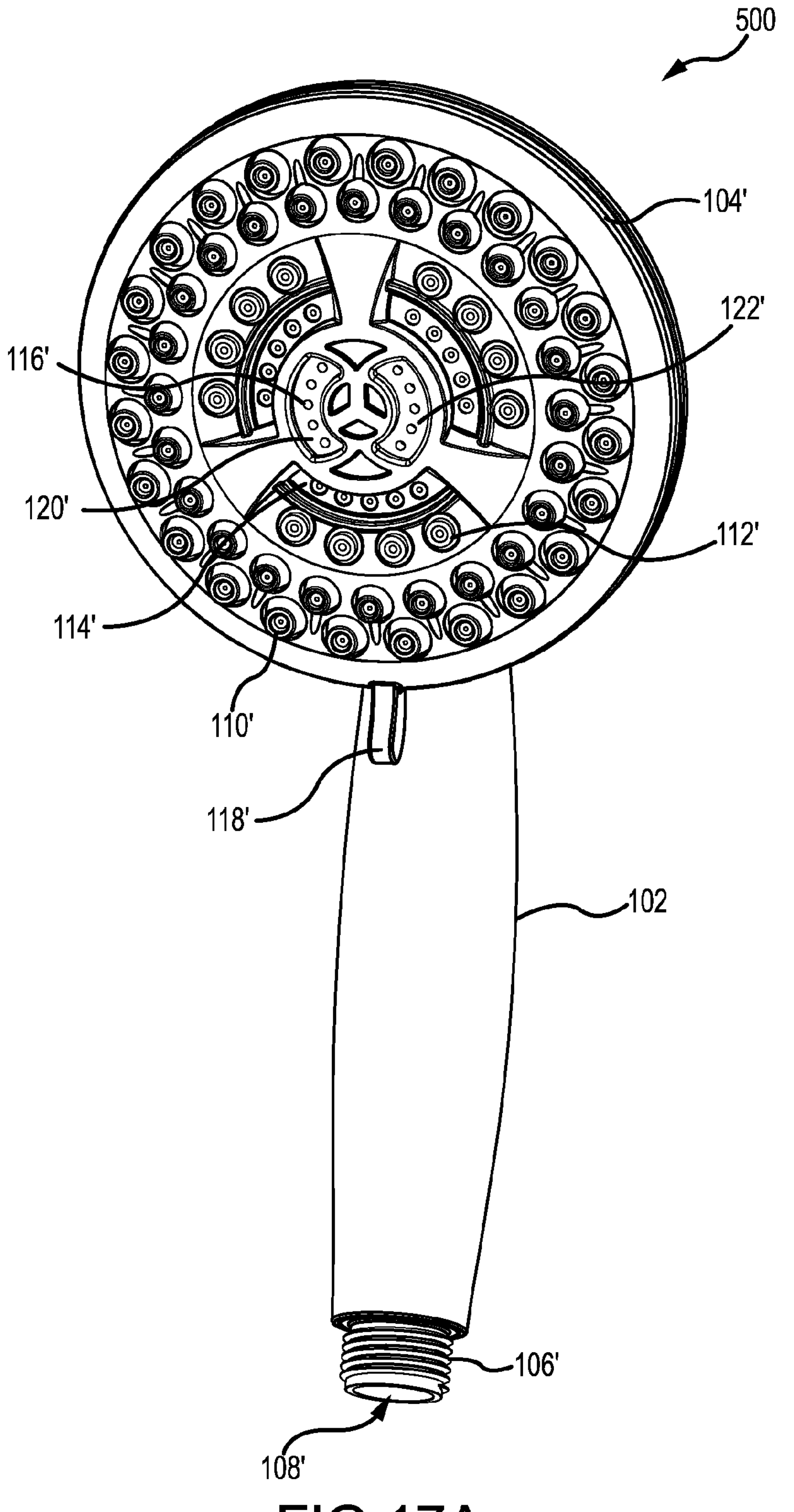


FIG.17A

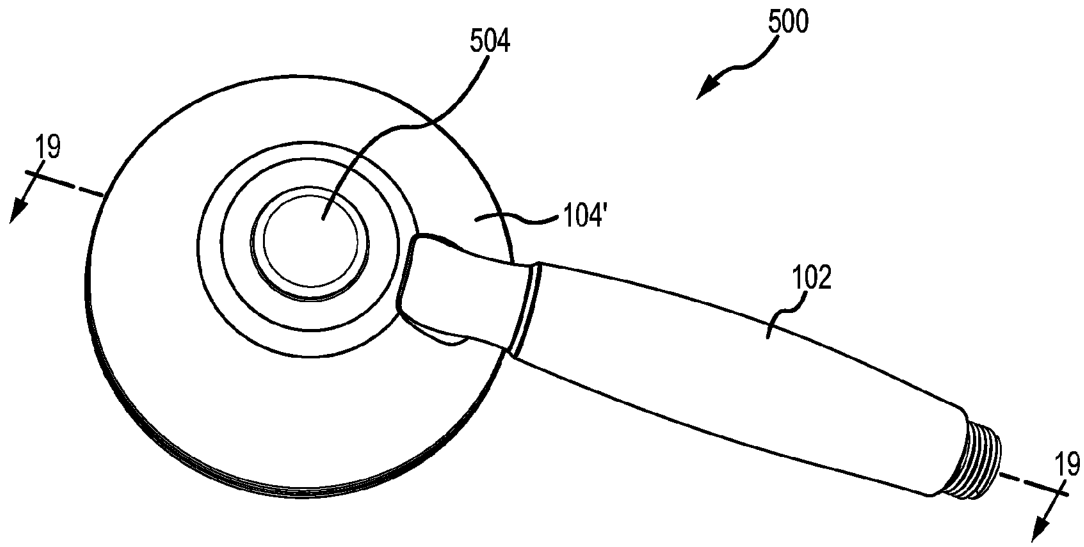


FIG.17B

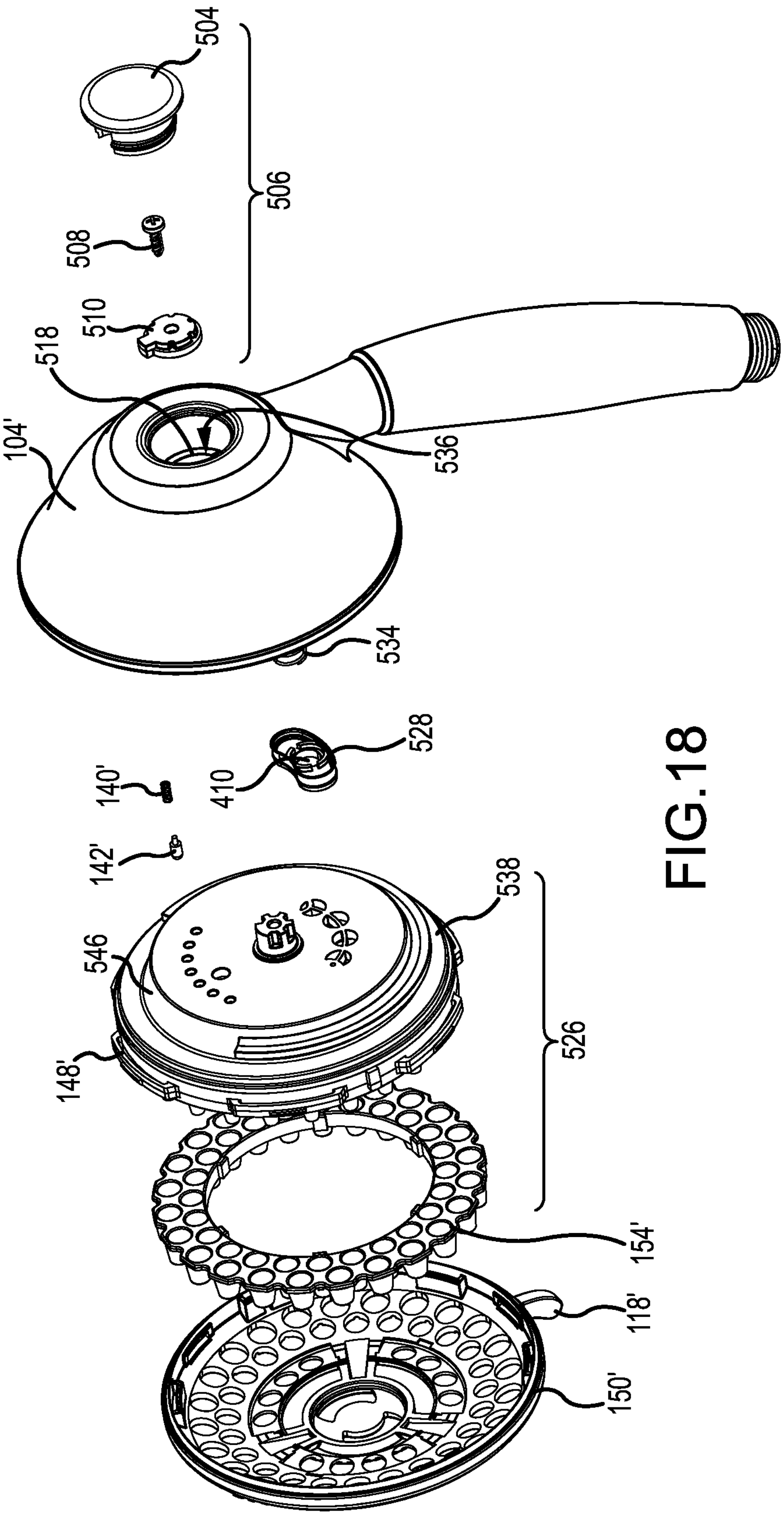
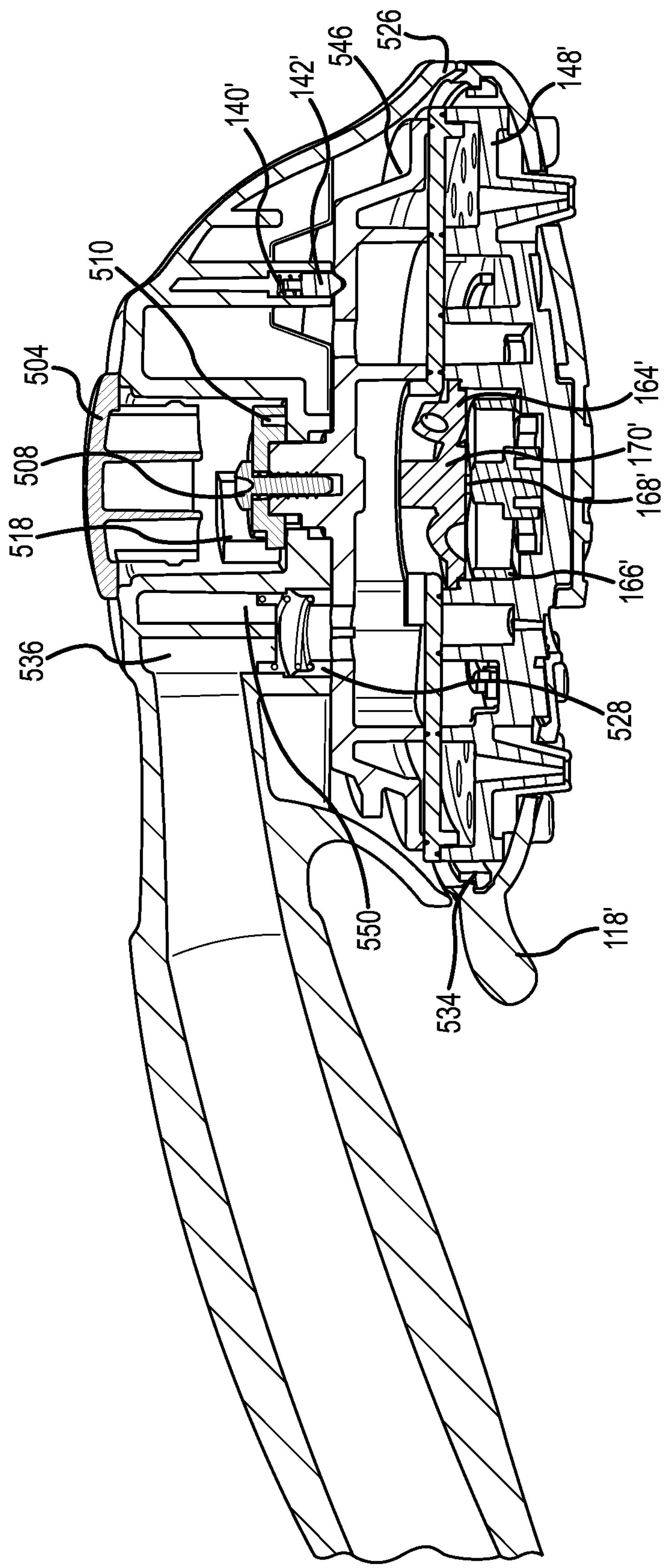

504
506
508
510
518
104'
536
534
528
410
140'
142'
538
546
526
148'
154'
118'
150'

FIG.18


526
546
142'
140'
148'
510
504
508
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536
164'
170'
168'
166'
528
550
118'
534

FIG.19

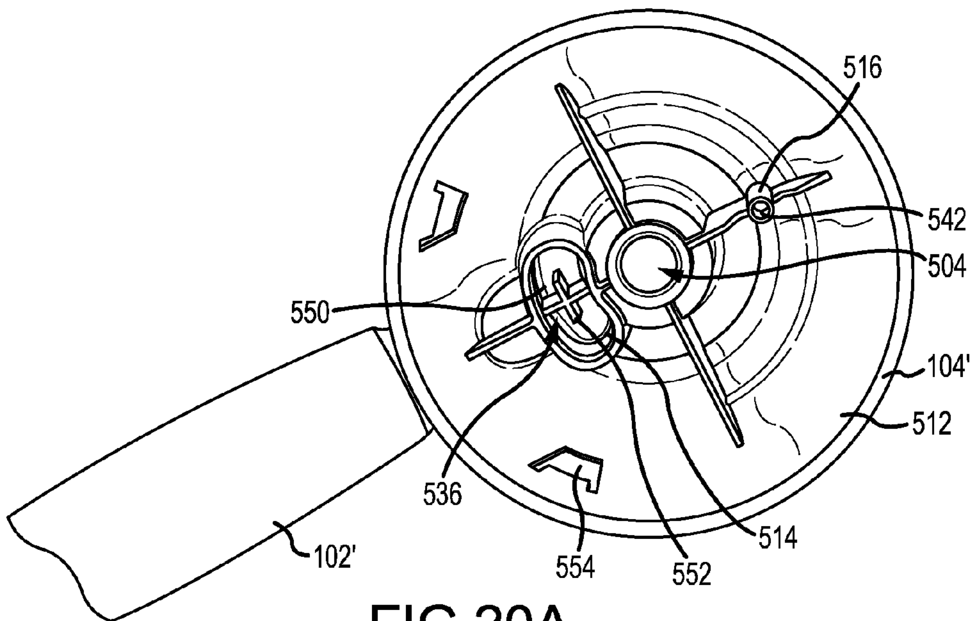


FIG.20A

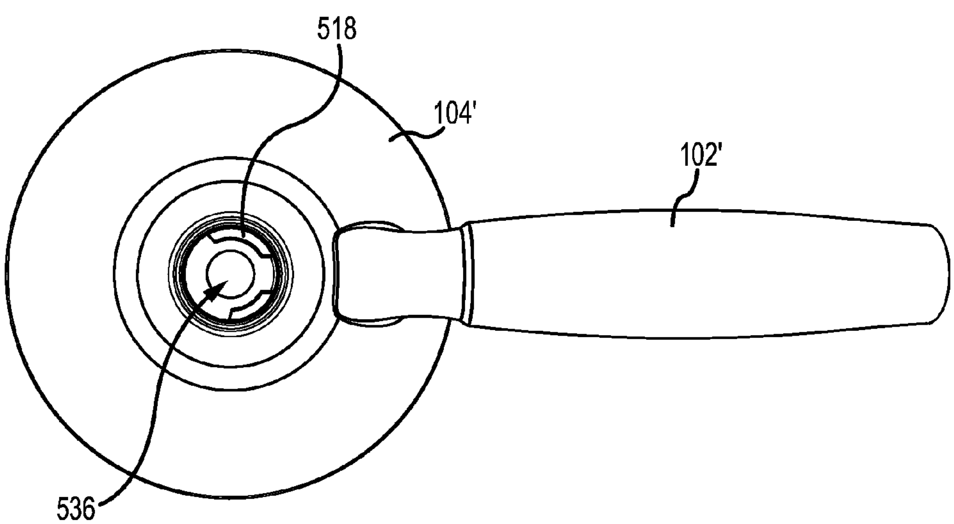


FIG.20B

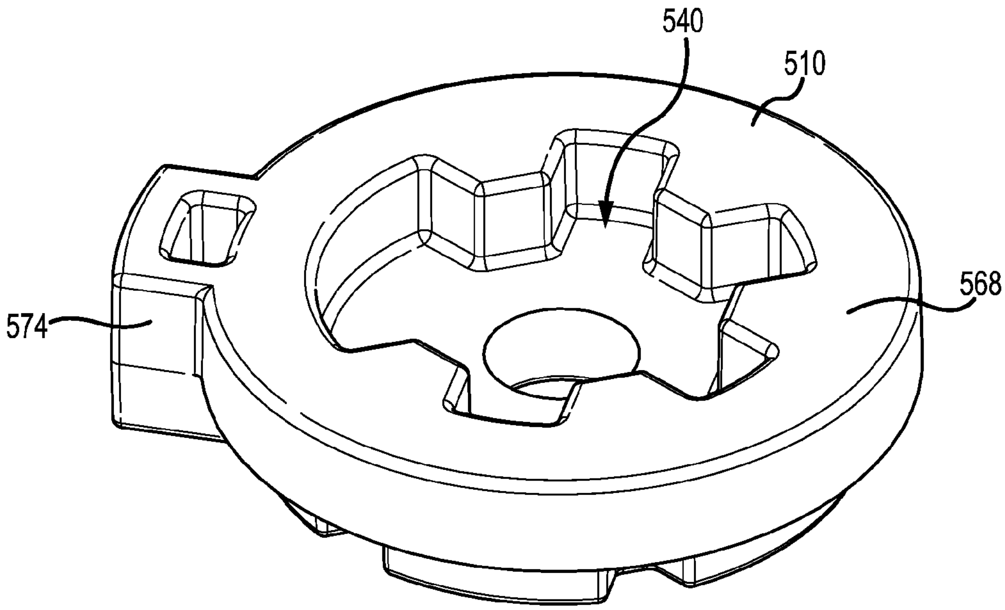


FIG.21A

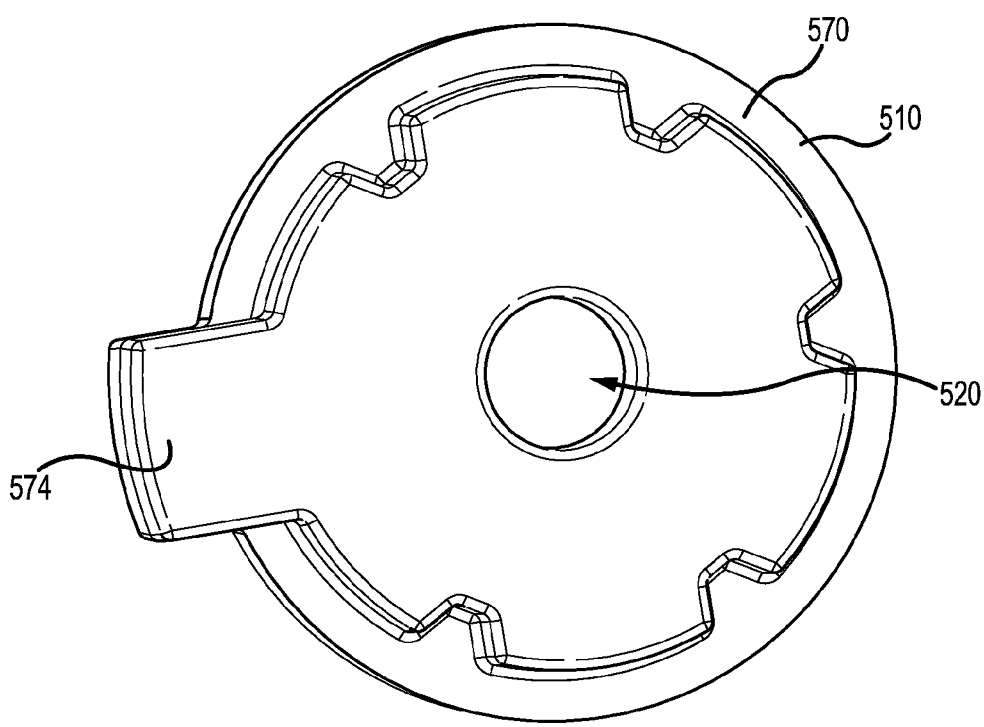


FIG.21B

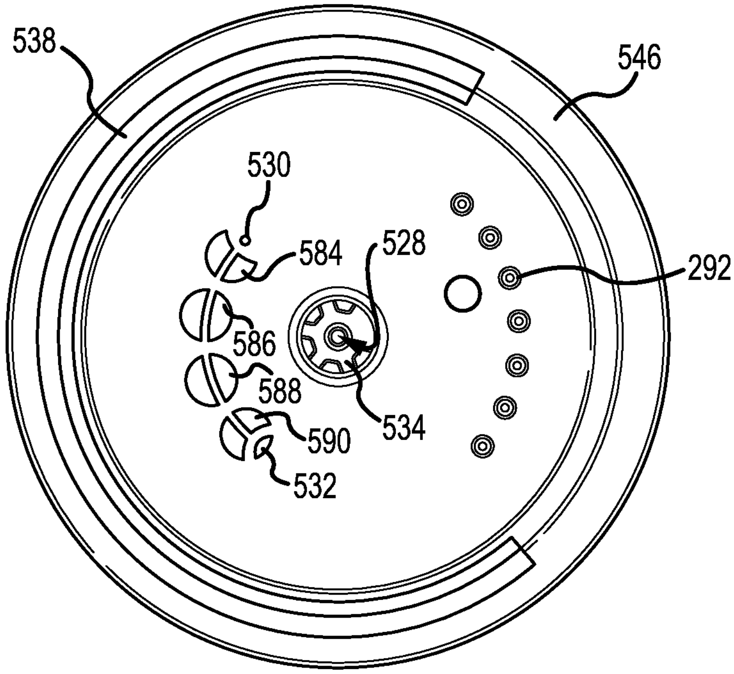


FIG.22A

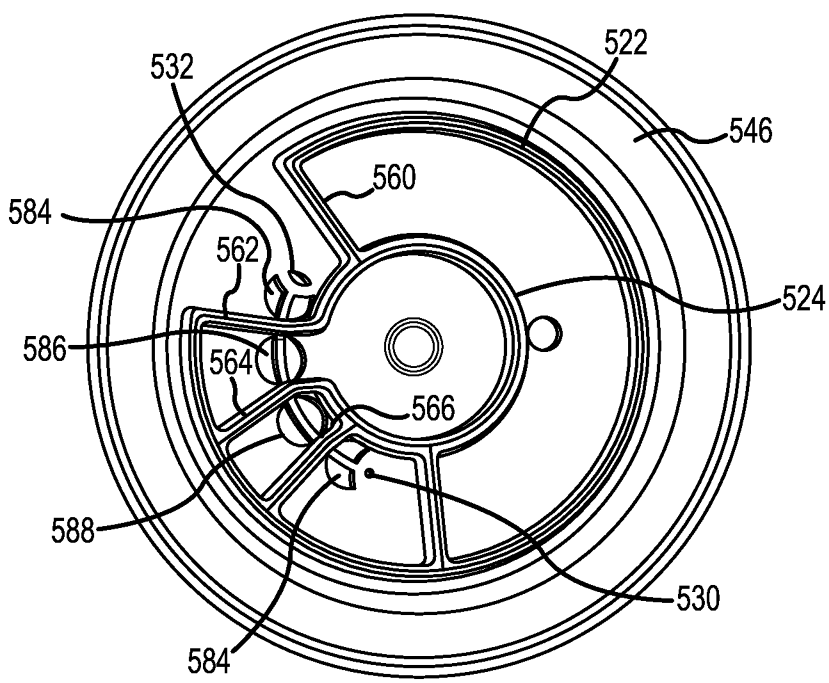


FIG.22B

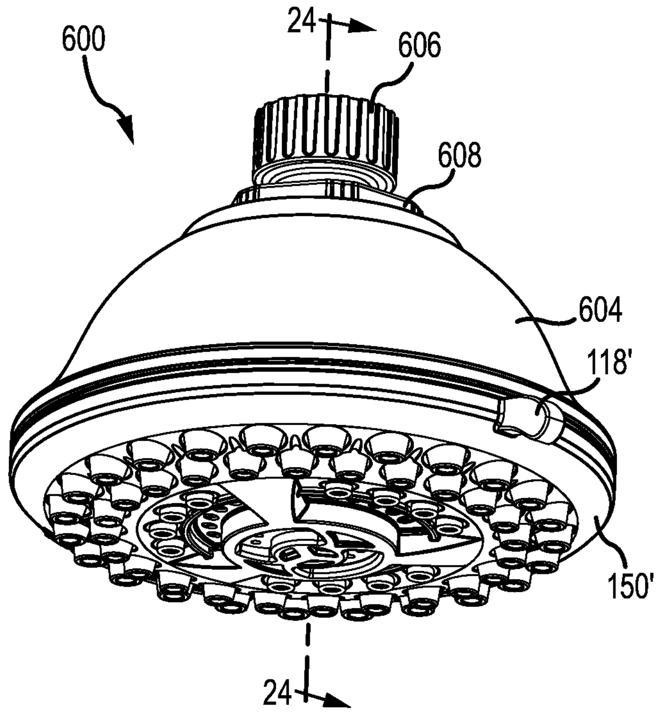

600
24
606
608
604
118'
150'
24

FIG.23

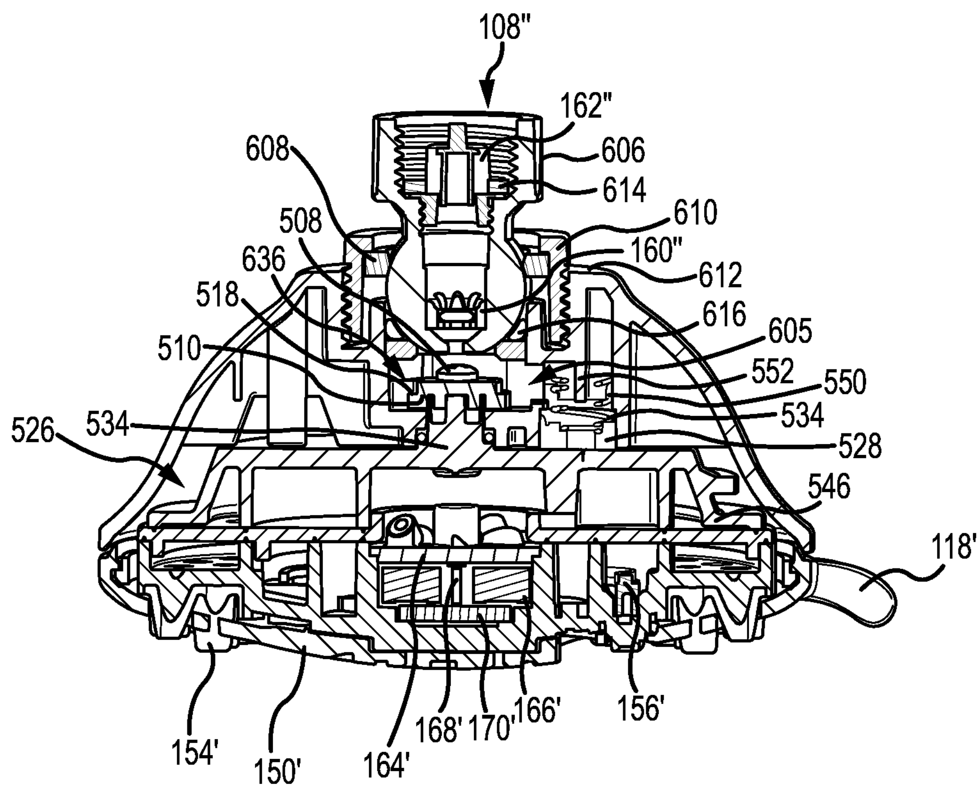

108"
162"
608
606
614
610
508
160"
636
612
518
616
510
605
552
550
526
534
534
528
546
118'
154'
150'
164'
168'
170'
166'
156'

FIG.24

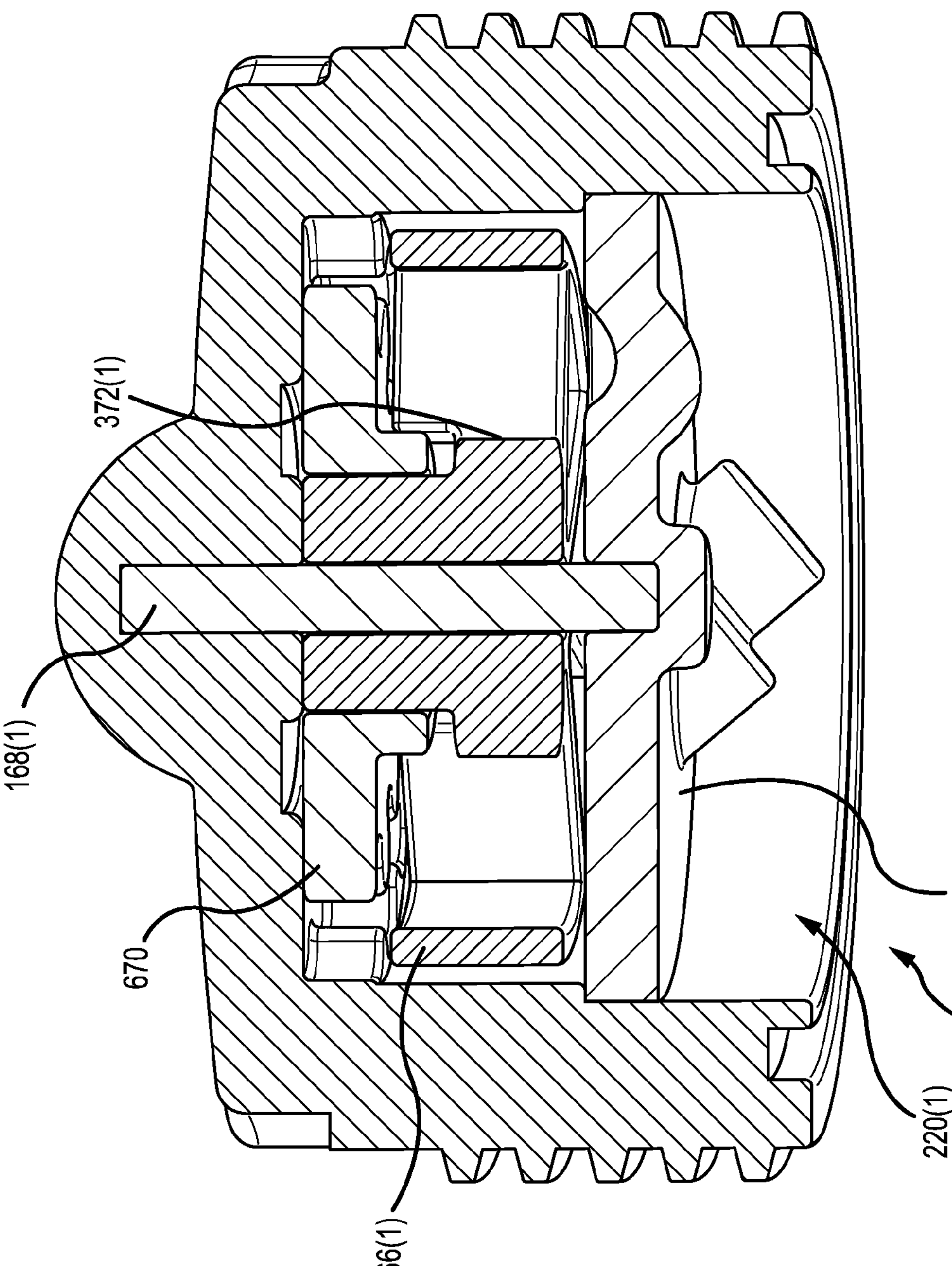


FIG.25

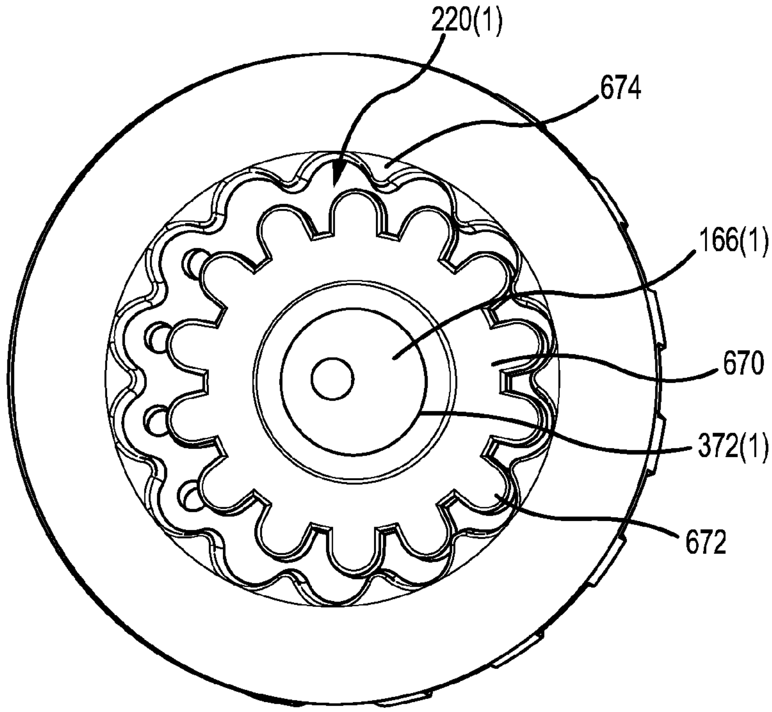


FIG.26A

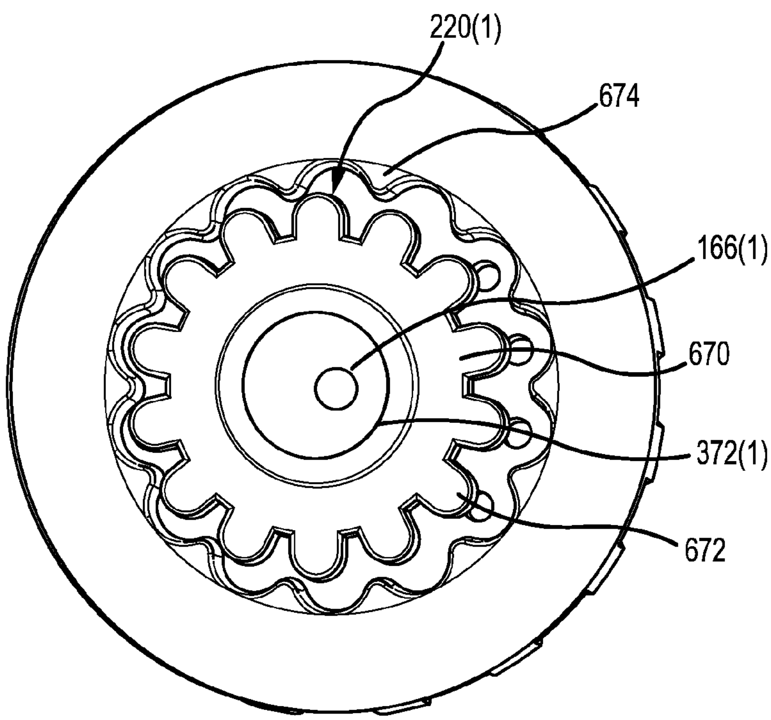


FIG.26B

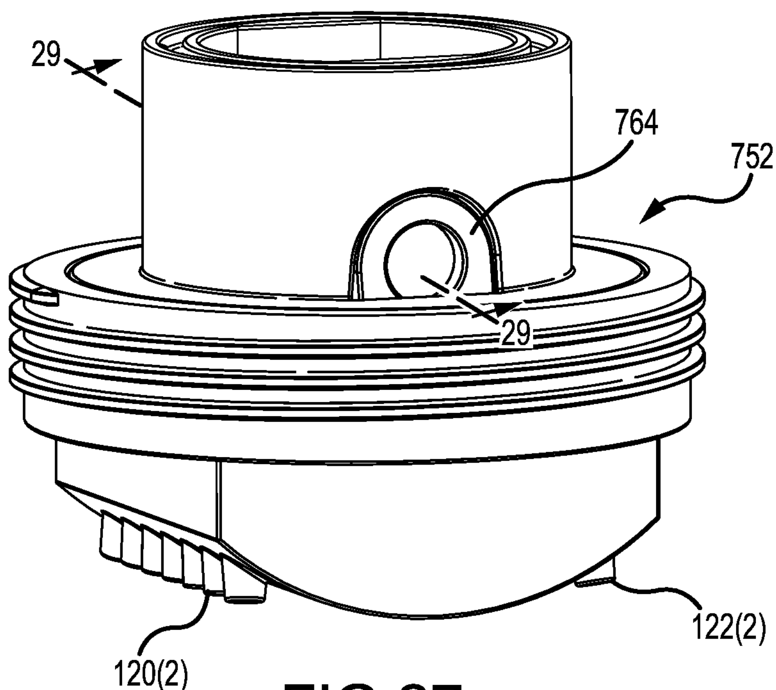


FIG.27

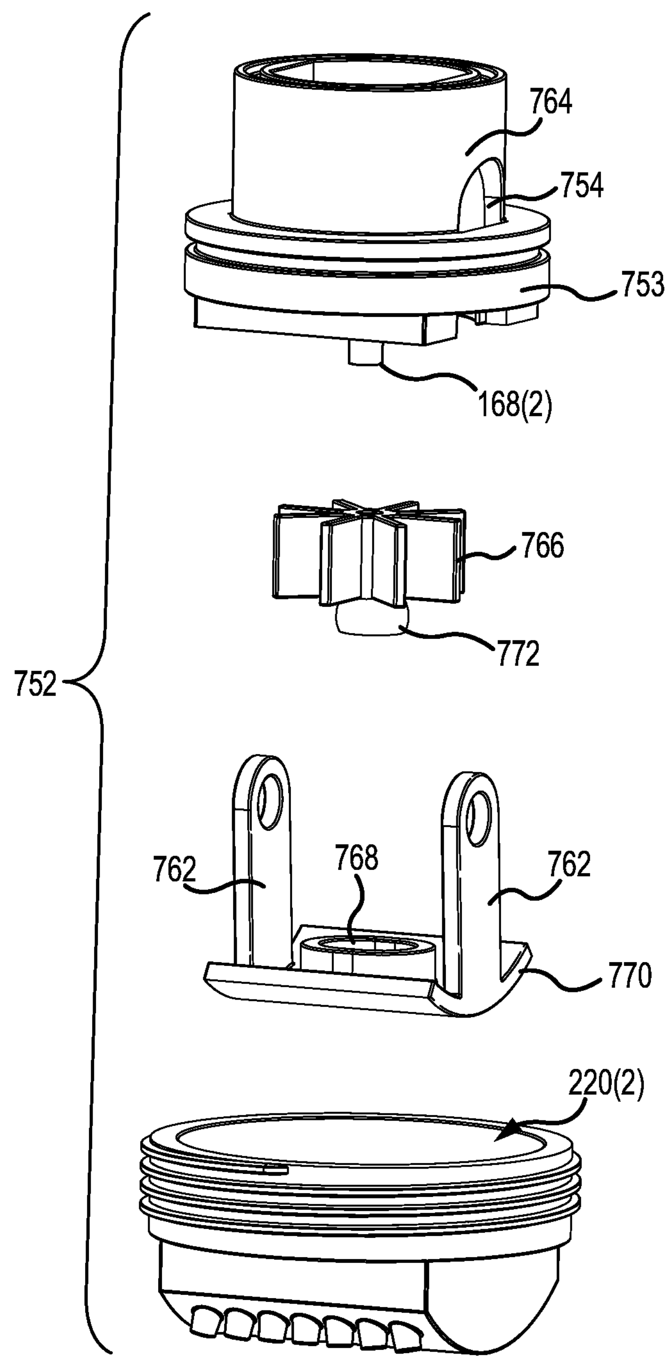


FIG.28

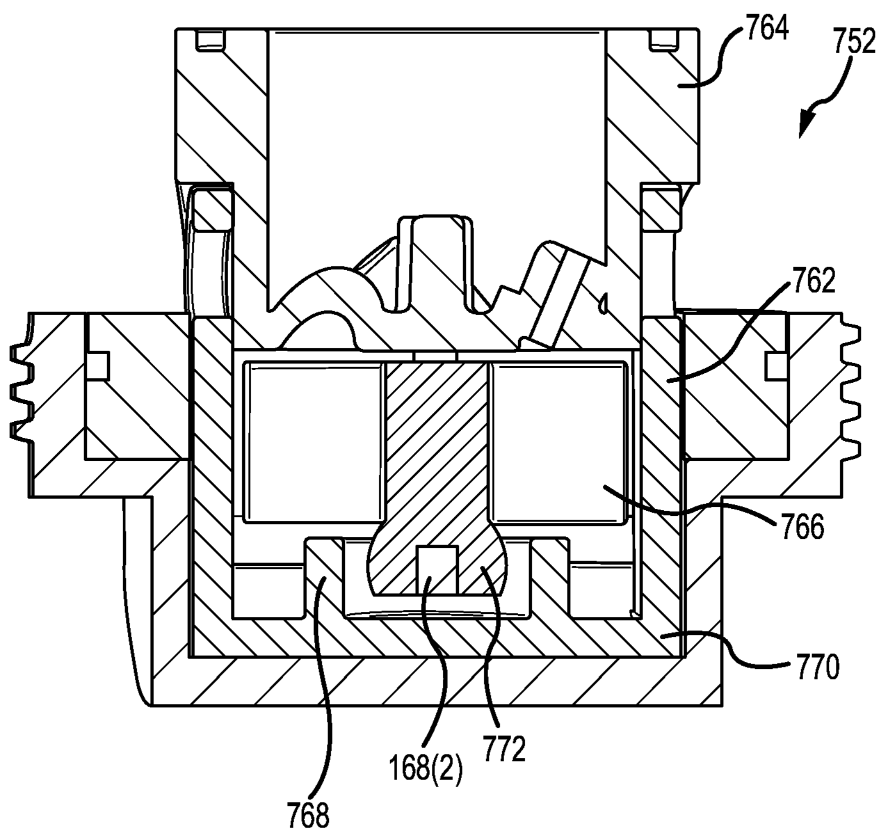


FIG.29

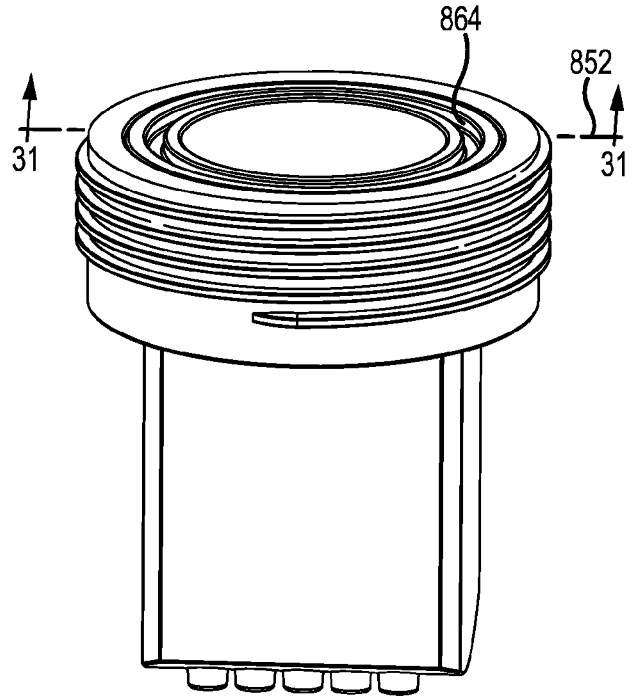


FIG.30

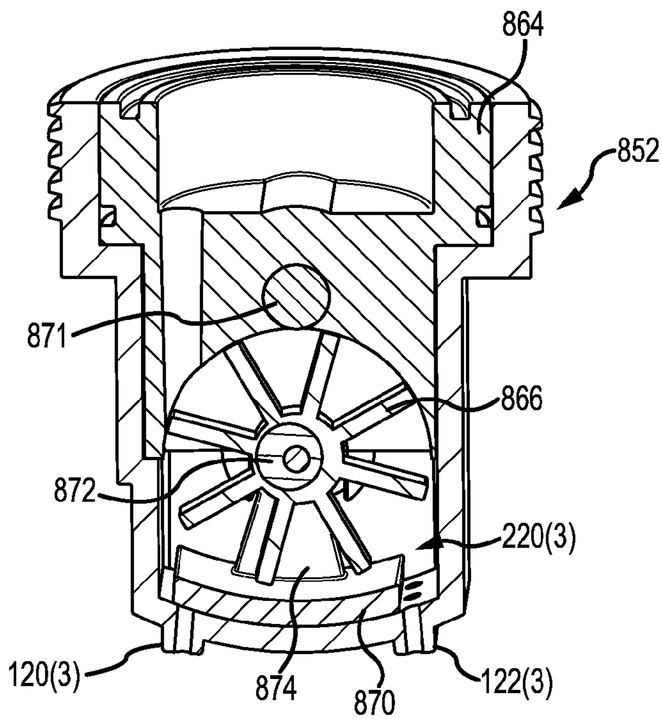


FIG.31

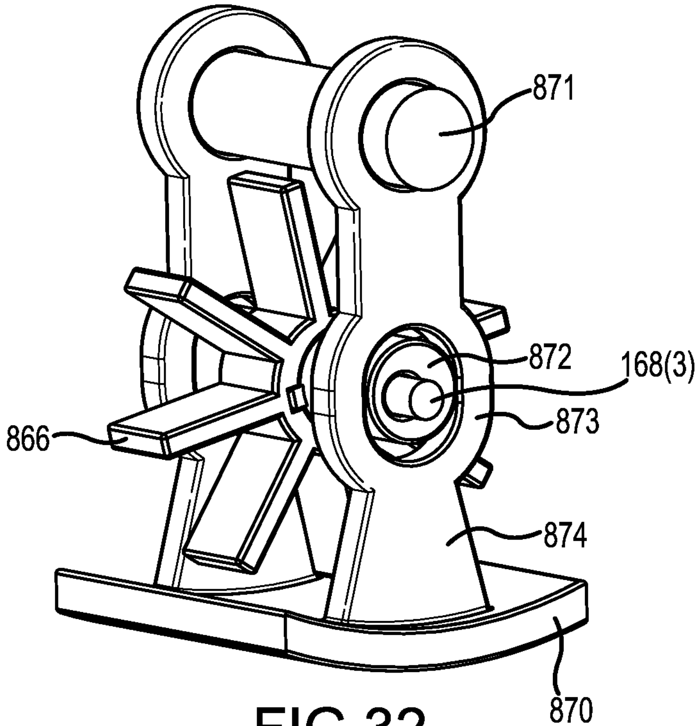
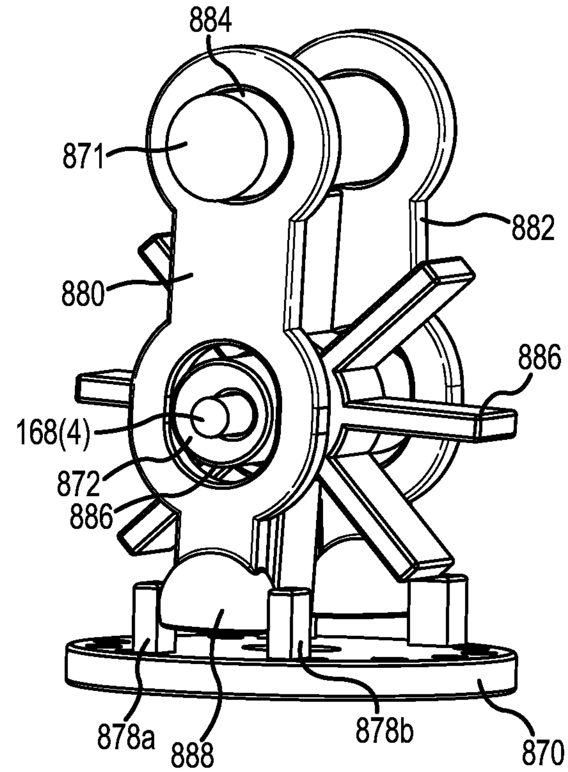

871
872
168(3)
873
866
874
870

FIG.32


884
871
882
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886
168(4)
872
886
878a
888
878b
870

FIG.33

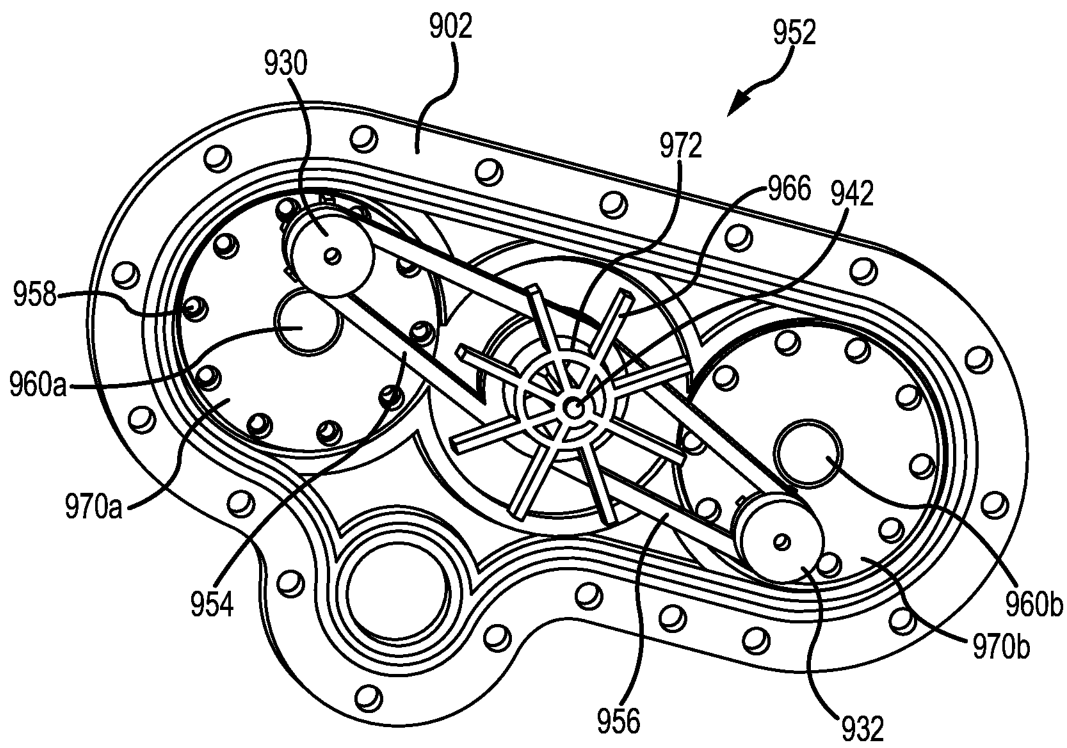

FIG.34

SHOWERHEAD WITH TURBINE DRIVEN SHUTTER

CROSS REFERENCE TO RELATED APPLICATIONS

The present application claims priority under 35 U.S.C. §119(e) to U.S. provisional patent application No. 61/834,816 filed 13 Jun. 2013 and entitled "Showerhead with Turbine Driven Shutter," which is hereby incorporated by reference herein in its entirety.

TECHNICAL FIELD

The technology disclosed herein relates generally to showerheads, and more specifically to pulsating showerheads.

BACKGROUND

Showers provide an alternative to bathing in a bathtub. Generally, showerheads are used to direct water from the home water supply onto a user for personal hygiene purposes.

In the past, bathing was the overwhelmingly popular choice for personal cleansing. However, in recent years showers have become increasingly popular for several reasons. First, showers generally take less time than baths. Second, showers generally use significantly less water than baths. Third, shower stalls and bathtubs with showerheads are typically easier to maintain. Fourth, showers tend to cause less soap scum build-up. Fifth, by showering, a bather does not sit in dirty water—the dirty water is constantly rinsed away.

With the increase in popularity of showers has come an increase in showerhead designs and showerhead manufacturers. Many showerheads emit pulsating streams of water in a so-called "massage" mode. Other showerheads are referred to as "drenching" showerheads, since they have relatively large faceplates and emit water in a steady, soft spray pattern.

The information included in this Background section of the specification, including any references cited herein and any description or discussion thereof, is included for technical reference purposes only and is not to be regarded subject matter by which the scope of the invention is to be bound.

SUMMARY

A showerhead per the disclosure herein has a water-powered turbine, a cam, and a shutter. The shutter is connected to the turbine and the cam so as to oscillate across groups of nozzle outlet holes in a massaging showerhead.

Another embodiment includes an apparatus including a turbine attached to a cam, where the turbine is operatively connected to two or more shutters through links. Movement of the turbine causes the shutters to oscillate across groups of nozzle outlet holes.

Yet another embodiment includes a showerhead including a housing defining a chamber in fluid communication with a fluid inlet such as a water source, a first bank of nozzles, and a second bank of nozzles. The showerhead also includes a massage mode assembly that is at least partially received within the chamber. The massage mode assembly includes a turbine, a cam connected to or formed integrally with the turbine, and a shutter connected to the cam. With the structure of the massage mode assembly, the movement of the shutter is restricted along a single axis such that as the turbine rotates, the cam causes the shutter to alternatingly fluidly connect and disconnect the first bank of nozzles and the second bank of nozzles from the fluid inlet.

Another embodiment of the present disclosure includes a method for producing a massaging spray mode for a showerhead. The method includes fluidly connecting a first plurality of nozzles to a fluid source, where each of the nozzles within the first plurality of nozzles are opened substantially simultaneously and fluidly disconnecting the first plurality of nozzles form the fluid source, where each of the nozzles in the first plurality of nozzles are closed substantially simultaneously.

Yet another embodiment of the present disclosure includes a showerhead having a spray head, an engine, and a face plate. The engine is fluidly connected to a water source and is received within the spray head. The engine may include a massage mode assembly that has a turbine and a shoe connected to the turbine, where the movement of the shoe is restricted to a single axis. As the turbine rotates, the shoe alternating fluidly connects and disconnects a first set of nozzle apertures and a second set of nozzle apertures, where each nozzle within the specific set is open and closed at substantially the same time. Additionally, the face plate is connected to the engine and is configured to selectively rotate the engine, in order to vary the spray characteristics of the showerhead.

Other embodiments include a method of assembling a showerhead. The method includes connecting together two or more flow directing plates to create an engine for the showerhead, placing the engine with a spray head a number of degrees out of phase from an operational orientation, rotating the engine the number of degrees into the operational direction, and connecting the engine to the spray head by a fastener received through a back wall of the spray head.

Another embodiment includes a showerhead having a housing defining a chamber in fluid communication with a fluid source, an engine received within the housing and fluidly connected to the chamber, where the engine includes a plurality of outlets in selective communication with the chamber, and an engine release assembly connected to the housing and the engine, where the engine release assembly selectively secures and releases the engine from the housing.

Still other embodiments include a showerhead with multiple modes. The showerhead includes a spray head fluidly connected to a fluid source and an engine at least partially received within the spray head. The engine includes a face plate defining a plurality of outlets and a back plate connected to the face plate. The connection between the face plate and the back plate defines at least a first fluid channel and a second fluid channel in selective fluid communication with the fluid source and with respective subsets of the plurality of outlets. The engine also includes a first mode aperture defined through the back plate and in fluid communication with the first fluid channel, a second mode aperture defined through the back plate and in fluid communication with the second fluid channel, and an alternate mode aperture defined through the back plate and in fluid communication with the first fluid source.

This Summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This Summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended to be used to limit the scope of the claimed subject matter. A more extensive presentation of features, details, utilities, and advantages of the present invention as defined in the claims is provided in the following written description of various embodiments of the invention and illustrated in the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1**A is an isometric view of a showerhead including a massage mode assembly.

FIG. 1B is a front elevation view of the showerhead of FIG. 1A.

FIG. 2 is an exploded view of the showerhead of FIG. 1A.

FIG. 3 is a cross-sectional view of the showerhead of FIG. 1A taken along line 3-3 in FIG. 1B.

FIG. 4 is an enlarged cross-sectional view of a portion of the showerhead of FIG. 1A as indicated in FIG. 3.

FIG. 5 is a rear isometric view of a cover plate for the showerhead.

FIG. 6A is a front isometric view of a face plate for the showerhead.

FIG. 6B is a rear isometric view of the face plate of FIG. 6A.

FIG. 7A is a front plan view of an inner plate of the showerhead.

FIG. 7B is a rear plan view of the inner plate of FIG. 7A.

FIG. 8A is a top plan view of a back plate of the showerhead.

FIG. 8B is a bottom plan view of the back plate of FIG. 8A.

FIG. 9A is a top isometric view of a mounting plate for the showerhead.

FIG. 9B is a bottom isometric view of the mounting plate of FIG. 9B.

FIG. 10 is a top isometric view of the massage mode assembly of the showerhead.

FIG. 11 is a cross-sectional view of the massage mode assembly taken alone line 11-11 in FIG. 10.

FIG. 12 is a bottom isometric view of the massage mode assembly of FIG. 10.

FIG. 13A is a bottom isometric view of a turbine for the massage mode assembly.

FIG. 13B is a top plan view of the turbine of FIG. 13A.

FIG. 14 is a cross-sectional view of the face plate and a mist ring of the showerhead of FIG. 1A.

FIG. 15 is an exploded view of a selecting assembly for the showerhead of FIG. 1A.

FIG. 16A is an enlarged cross-section view of the massage mode assembly with the shutter in a first position.

FIG. 16B is an enlarged cross-section view of the massage mode assembly with the shutter in a second position.

FIG. 17A is an isometric view of a second example of a showerhead including the massage mode assembly.

FIG. 17B is a rear isometric view of the showerhead of FIG. 17A.

FIG. 18 is an exploded view of the showerhead of FIG. 17A.

FIG. 19 is a cross-section view of the showerhead of FIG. 17A taken along line 19-19 in FIG. 17B.

FIG. 20A is a front isometric view of a spray chamber housing of the showerhead of FIG. 17A.

FIG. 20B is a rear plan view of the housing of the showerhead of FIG. 17A.

FIG. 21A is a bottom isometric view of a keyed washer of the showerhead of FIG. 17A.

FIG. 21B is a top isometric view of the keyed washer of FIG. 21A.

FIG. 22A is a top plan view of a back plate of the showerhead of FIG. 17A.

FIG. 22B is a bottom plan view the back plate of FIG. 22A.

FIG. 23 is an isometric view of a third example of a showerhead including a massage mode assembly.

FIG. 24 is a cross-section view of the showerhead of FIG. 23 taken along line 24-24 in FIG. 23.

FIG. 25 is a cross-section view of a first example of a massage mode assembly.

FIG. 26A is a cross-section view of the massage mode assembly of FIG. 25 with the shutter in a first position.

FIG. 26B is a cross-section view of the massage mode assembly of FIG. 25 with the shutter in a second position.

FIG. 27 is an isometric view of a second example of a massage mode assembly.

FIG. 28 is an exploded view of the massage mode assembly of FIG. 27.

FIG. 29 is a cross-section view of the massage mode assembly of FIG. 28 taken along line 29-29 in FIG. 28.

FIG. 30 is an isometric view of a third example of a massage mode assembly.

FIG. 31 is a cross-section view of the massage mode assembly of FIG. 30 taken along line 31-31 in FIG. 30.

FIG. 32 is an isometric view of a fourth example of a massage mode assembly.

FIG. 33 is an isometric view of a fifth example of a massage mode assembly.

FIG. 34 is a top isometric view of a sixth example of a massage mode assembly.

DETAILED DESCRIPTION

This disclosure is related to a showerhead including a pulsating or massaging spray. The showerhead may include a massage mode assembly including a jet disk, a turbine, a shutter, and a housing. The massage mode assembly is used to create the pulsating or intermittent spray. In one embodiment, the turbine defines one or more cams or cam surfaces and the shutter, which may be restrained in certain directions, follows the movement of the cam to create the pulsating effect by selectively blocking and unblocking outlet nozzles.

In operation, water flowing through the showerhead causes the turbine to spin and, as the turbine spins, the cam rotates causing the shutter to oscillate. In examples where the shutter movement is constrained in one or more directions, the shutter may move in a reciprocal motion, such as a back and forth motion, rather than a continuous motion. The reciprocal motion allows a first group of nozzles to be covered by the shutter, while a second group of nozzle is uncovered and, as the shutter reciprocates, the shutter moves to close the second group of nozzles at the same time that the first group of nozzles is opened. In many embodiments the nozzles in both groups may not be open or “on” at the same time. In particular, nozzles from a first nozzle group may be closed while nozzles from the second group are open and vice versa. As such, the showerhead may not include a set of “transitional” nozzles, i.e., nozzle groups in which the nozzles in a group progressively open and close such as due to a rotating shutter.

The binary functionality of the massage mode or pulsating mode allows the showerhead to produce a stronger fluid force during the pulsating mode, allowing the user to experience a more intense “massage” mode, even with lower fluid flow rates. In some instances the pulse mode may be 50% more forceful than the pulse mode of conventional “progressive” pulse showerheads. Thus, the showerhead may be able to conserve more water than conventional showerheads, while avoiding a decrease in force performance, and in fact may allow a user to experience a greater force during the massage mode.

In some embodiments, a pulsating showerhead spray may be formed by an oscillating shutter. The shutter may be configured to oscillate past the openings of discreet sets of spray nozzles. As an example, the shutter may be actuated by one or more eccentric cams attached to, or formed integrally with, the water driven turbine. These elements include one or more shutters operating in an oscillatory fashion, a turbine with one or multiple cams, and two or more individual groups of water outlet nozzles. Other embodiments may also include links between the cam(s) and shutter(s).

Some embodiments of showerheads of the present disclosure may also include a pause or trickle mode. For example, in one embodiment the showerhead may include a plurality of modes, such as full body mode, massage mode, mist mode, and a trickle mode. The trickle mode allows a minimum amount of flow to exit the showerhead when the water source is on. Depending on the structural characteristics of the showerhead, such as the housing and flow directing plates, the trickle mode may prevent substantially all flow from the showerhead out of the nozzles, to "pause" the showerhead flow without requiring a user to turn the water supply off. As one example, the showerhead may include a back plate with a plurality of mode apertures, where each mode aperture corresponds to a particular fluid channel and nozzle group of the showerhead. In this example, the trickle mode may include a mode aperture that has a smaller width than the remaining showerhead modes, so that the flow of water into the fluid channel is restricted. In addition to or separate from the trickle mode, the showerhead may also include a low flow mode as a water saving feature. The low flow mode may correspond to a low flow aperture that may be larger than the trickle mode aperture, but smaller than the regular mode apertures.

In embodiments including the trickle mode and the low flow mode, the trickle mode aperture and the low flow aperture may be selected by over-clocking or chocking a mode selector assembly to an extreme position. The fluid from a water source may then be directed toward the desired trickle mode or low flow mode, with the diameter of the corresponding mode aperture determining the flow rate output by the showerhead.

Additionally, in some embodiments the various components of the showerhead may be configured to be assembled and disassembled quickly and repeatedly. For example, the showerhead may include a handle having a spray head, a face plate cover, and an engine. The engine may include the various internal components of the showerhead such as the massage mode assembly, one or more flow directing plates, and so on. The engine is received within the spray head and the cover is secured to the engine and showerhead to secure the engine within the spray head. The engine may be configured to engage one or more keying elements in the spray head, cover, housing, or other component such as a mounting plate connected thereto. A fastener or other component may be used to secure the engine to the spray head once the engine is rotated to a desired, locked position. The fastener may be easily accessible from the exterior of the showerhead to allow the fastener to be removed without damaging the housing. Once the fastener is removed the engine can rotated out of alignment with the keying features and removed easily without damaging the other components.

In one example, the fastener may include a snap-fit connection between a back plate of the engine and a mounting plate connected to the housing or the housing itself. In this example, the engine may be snapped into place within the spray head. In another example, the fastener may be a screw or other threaded element that is threaded to a keyed washer. The keyed washer may be connected to the engine through a cap cavity in a back wall of the spray head or other housing. In this example, the showerhead may include a decorative cap that may conceal the fastener when the showerhead is assembled.

In embodiments where the engine may be selectively attached and detached from the spray head, the showerhead may be manufactured at a lower cost with increased reliability. In particular, often the handle and/or cover may be plated with an aesthetically pleasing material, such as a chrome or metal plating. These may be the most expensive components of the showerhead as the remaining components may be constructed out of plastic and other relatively inexpensive materials. In conventional showerheads, once the showerhead had been assembled, the engine could not be removed without damaging components of the showerhead. As such, if one or more components within the engine were damaged or flawed, the entire showerhead was often tossed out. However, in embodiments having the removable engine, the showerheads can be assembled, tested, and, if a component is not operating as desired, the engine can be removed and replaced without disposing of the more expensive components as well.

Turning to the figures, showerhead embodiments of the present disclosure will now be discussed in more detail. FIGS. **1**A and **1**B are various views of the showerhead. FIG. **2** is an exploded view of the showerhead of FIG. **1**A. FIGS. **3** and **4** are cross-section views of the showerhead of FIG. **1**A. With reference to FIGS. **1**A-**2**, the showerhead **100** may include a handle **102** and a spray head **104**. In the embodiment shown in FIGS. **1**A-**2**, the showerhead **100** is a handheld showerhead. However, in other embodiments (see, e.g., FIG. **23**), the showerhead **100** may be a fixed or wall mount showerhead, in which case the handle **102** may be omitted or reduced in size. The handle **102** defines an inlet **108** for the showerhead **100** that receives water from a fluid source, such as a hose, J-pipe, or the like. Depending on the water source, the handle **102** may include threading **106** or another connection mechanism that can be used to secure the handle **102** to the hose, pipe, etc.

In embodiments where the showerhead **100** is a handheld showerhead, the handle **102** may be an elongated member having a generally circular cross section or otherwise be configured to be comfortably held in a user's hand. Additionally, as shown in FIG. **2**, the showerhead **100** may also include a flow regulator **160** and a filter **162** that are connected to the handle **102**.

With reference to FIGS. **1**A and **1**B, the spray head **104** includes a plurality of output nozzles arranged in sets or groups, e.g., a first nozzle group **110**, a second nozzle group **112**, a third nozzle group **114**, and a fourth nozzle group **116**, that function as outlets for the showerhead **100**. As will be discussed in more detail below, each of the selected nozzle groups **110**, **112**, **114**, **116** may be associated with a different mode for the showerhead **100**. Additionally, certain groups of nozzles, such as the fourth nozzle group **116** may include nozzle subsets such as a first nozzle bank **120** and a second nozzle bank **122**. In this example, the two nozzle banks **120**, **122** may be crescent shaped, include five nozzles, and may be positioned opposite one another. However, the example shown in FIGS. **1**A and **1**B is meant as illustrative only and many other embodiments are envisioned. The showerhead mode is varied by rotating the mode selector **118**, which in turn rotates an engine **126** received within the spray head **104**, which will be discussed in more detail below.

With reference to FIG. **2**, the showerhead **100** may include the engine **126** having a plurality of flow directing plates, **146**, **158**, **146**, a massage assembly **152**, and additional mode varying components. The engine **126** is received within the spray head **104** and a cover **150** contains the engine **126** within the spray head **104** and provides an aesthetically pleasing appearance for the showerhead **100**. FIG. **5** is a rear isometric view of the cover. With reference to FIGS. **1**A, **2**, and **5**, the cover **150** is configured to generally correspond to the front end of the spray head **104** and may be a generally circularly shaped body. The cover **150** defines a plurality of apertures, such as the nozzle apertures **178** and the bank apertures **180***a*, **180***b*. As will be discussed below these apertures **178**, **180***a*, **180***b* receive nozzles that form the nozzle groups **110**, **112**, **114**, **116** of the showerhead **100**. Accordingly, the shape, size, and position of the nozzle apertures **178** and bank apertures **180***a*, **180***b* may be provided to correspond to the number and position of the mode nozzles.

The cover **150** forms a cup-like structure on the rear side that defines a cover chamber **172**. The cover chamber **172** may be configured to receive one or more components of the engine **126**. A plurality of alignment brackets **174** define the perimeter of the cover chamber **172** and extend upward from an interior bottom wall **184**. The alignment brackets **174** have a curvature substantially matching the curvature of the perimeter of the cover **150** and are spaced apart from one another around the perimeter. In one embodiment the showerhead cover **150** may include seven alignment brackets **174**. However, the number of brackets **174** and the spacing between the brackets **174** may be varied based on the diameter of the cover **150**, the number of modes for the showerhead **100**, and other factors. Additionally, although a plurality of alignment brackets **174** are illustrated, in other embodiments the cover **150** may include a single outer wall defining the perimeter of the cover chamber **172**. Each alignment bracket **174** may include a bracket aperture **176** defined therethrough.

With reference to FIG. **5**, the alignment brackets **174** may be spaced apart from a top edge of a rim **186** forming the back end of the cover **150**. The spacing between the brackets **174** and the top edge of the rim **186** defines a gap **188**.

The interior bottom wall **184** of the cover **150** may include a center area **190** that is recessed further than the other portions of the bottom wall **184**. The center area **190** may be located at a central region of the cover **150**. A small disk-shaped recess **182** may be formed at the center point of the center area **190**. The recess **182** is located below the interior surface of the center area **190** and extends outward past the exterior of the center area **190**. The mode selector **118** may be a finger grip formed integrally with the cover **118** and extending outward from the rim **186**.

The face plate **148** will now be discussed in more detail. FIGS. **6**A and **6**B are front and rear perspective views of the face plate **148**. FIG. **14** is a cross-section view of the face plate **148** and mist plug ring **156**. The face plate **148** includes a front surface **192** and a rear surface **194**. The front surface **192** defines a plurality of outlets **198**, **200** as well as the nozzles for select nozzle groups **112**, **114**. Depending on the desired spray characteristics for each mode of the showerhead **100**, the outlets **198**, **200** and nozzles **112**, **114** may be raised protrusions with an outlet in the middle, apertures formed through the face plate **148**, or the like. For example, the nozzles for the second nozzle group **112** may include raised portions that extend outward from the front surface **192** of the face plate **148** and on the back surface **194** may include nozzle chambers **226**. The nozzle chambers **226** may be formed as individual cylindrical cavities that funnel toward the nozzle outlet. Each nozzle chamber **226** may include an interior shelf **228** defined toward a bottom end of the chamber **226**. The interior shelf **228** reduces the diameter of the chamber **226** before the nozzle outlet, which may be formed as a mist outlet **4 422** defined through the shelf **228** on the bottom of the chambers **226**.

With continued reference to FIGS. **6**A, **6**B and **14**, the face plate **148** may include a raised platform **194** extending outward from a central region of the face plate **148**. The platform **194** may include two curved sidewalls **202** facing one another and two straight sidewalls **204** connecting the two curved sidewalls **202**. The raised platform **194** also includes a nub **196** extending outward from the center of the platform **194**. The two nozzle banks **120**, **122** are defined as raised, curved formations on the top of the platform **194**. In this example, the two nozzle banks **120**, **122** are curved so as to form opposing parenthesis shapes facing one another with the nub **196** being positioned between the two banks **120**, **122**. The banks **120**, **122** may generally match the curvature of the curved sidewalls **202** of the platform **194**. Each bank **120**, **122** may include a plurality of outlets **198**. In one example, each bank **120**, **122** may include five outlets **198**; however, the number of outlets **198** and the positioning of the outlets may vary based on the desired output characteristics of the showerhead **100**.

The nozzle groups **112**, **114** may be formed in concentric rings surrounding the platform **194**. In this manner, the banks **120**, **122** may form the innermost ring of nozzles for the showerhead **100** with the remaining nozzle groups **110**, **112**, **114** surrounding the banks **120**, **122**.

With reference to FIG. **6**B, the face plate **148** may also include a perimeter wall **206** extending outward from the perimeter edge of the bank surface **194**. The perimeter wall **206** forms an outer wall of the face plate **148**. The face plate **148** may include a plurality of concentric ring walls **230**, **232**, **234** that along with the perimeter wall **206** define a plurality of flow paths **212**, **214**, **216**, **218**. For example, the first ring wall **230** extends upward from the back surface **194** of the face plate **148** but is positioned closer toward the center of the face plate **148** than the outer perimeter wall **206**. The gap between the perimeter wall **206** and the first ring wall **230** defines the first flow path **212** and includes a first set of outlets **200**. As another example, the first ring wall **230** and the second ring wall **232** define the second flow path **214** that includes the second nozzle group **112** and the second ring wall **232** and the third ring wall **234** define the third flow path **216**. When the face plate **148** is connected to the other plates of the showerhead **100**, the flow paths **212**, **214**, **216**, **218** defined by the various walls **206**, **230**, **232**, **234** correspond to fluid channels for discrete modes of the showerhead **100**. As should be understood, the walls **206**, **230**, **232**, **234** prevent fluid from one flow path **212**, **214**, **216**, **218** from reaching outlets and/or nozzles in another flow path when the engine **126** is assembled. The shape and locations of the walls may be varied based on the desired modes for the showerhead.

The third ring wall **234** defines the fourth flow path **218**, as well as a massage chamber **220**. The massage chamber **220** is configured to receive the massage assembly **152** as will be discussed in more detail below. The massage chamber **220** may include an annular wall **236** concentrically aligned and positioned against the third ring wall **234**. However, the annular wall **236** is shorter than the third ring wall **234** so that it defines a shelf within the massage chamber **220**.

A bottom surface of the massage chamber **220** includes two curb walls **2222**. The curb walls **2 222** extend toward a center of the chamber **220** and include a straight edge that varies the geometry of the bottom end of the chamber **220**. The two curbs **2 222** oppose each other to transform the bottom end of the chamber **220** to a rectangle with curved ends or a truncated circle. The curb walls **2 222** generally correspond to the straight edges **204** of the platform **194** on the front surface **192** of the face plate **148**.

A pin recess **224** is defined at the center of the chamber on the bottom surface and extends into the back of the nub **196**. The pin recess **224** is configured to receive and secure a pin from the massage assembly **152** as will be discussed in more detail below. Additionally, the nozzle outlets **198** for each bank **120**, **122** are defined along a portion of the bottom surface of the massage chamber **220**.

The engine **126** may also include an inner plate **158**. The inner plate **158** may define additional modes for the showerhead. However, in embodiments where fewer modes may be desired, the inner plate may be omitted (see, e.g., FIGS. **17**A-**24**) FIGS. **7**A and **7**B illustrate front and rear views, respectively, of the inner plate **158**. With reference to FIGS. **7**A and **7**B, the inner plate **158** may be a generally circular plate having a smaller diameter than the face plate **148**. The inner plate **158** may include a plurality of tabs **258** extending outward from a sidewall of the inner plate **158**. A massage aperture **252** is formed through the center of the inner plate **158** such that the inner plate **158** has a ring or donut shape. Similar to the face plate **148**, the inner plate **158** may include a plurality of walls defining a plurality of flow paths. For example, the inner plate **158** may include an outer perimeter wall **242** along the outer perimeter of the plate **158** and first and second ring walls **244**, **246** defined concentrically within the perimeter wall **242**. The perimeter wall **242** and the first and second ring walls **244**, **246** extend from both the front and rear surfaces **238**, **240** of the inner plate **158**. The perimeter wall **242** and the first and second ring walls **244**, **246** form closed concentric circles on the front surface **238**. The perimeter wall **242** and the first ring wall **244** define a first flow path **248** and the first ring wall **244** and the second ring wall **246** define a second flow path **250**. Each of the flow paths **248**, **250** include apertures **254**, **256** defined through the front surface and rear surfaces **238**, **240** of the inner plate **158**. As will be discussed in more detail below, the flow paths **248**, **250** and the respective apertures **254**, **256** fluidly connect select nozzle groups based on the selected mode of the showerhead **100**.

With reference to FIG. **7**B, the inner plate **158** may include a first finger **260** and a second finger **262** that project into the mode aperture **252** on the rear side of the inner plate **158**. As will be discussed in more detail below, the fingers **260**, **262** provide structural support for the mode selection components and help direct water to a desired fluid channel. The first finger **260** is fluidly connected to the second flow path **250**. On the rear surface **240** of the inner plate **158**, the second finger **262** includes a plurality of separating walls **264**, **266**, **268** that intersect with one or more of the outer wall **242**, first ring wall **244**, and/or second ring wall **246**. For example, the first separating wall **264** bisects the second finger **262** to define a first portion **270** and a second portion **272**. The first separating wall **264** intersects with the outer wall **242**. The second separating wall **266** is defined on an outer edge of the second finger **262** and intersects with both the outer wall **242** and the first ring wall **244** to fluidly separate the first flow path **248** from the first portion **270** of the second finger **262**. Similarly, the third separating wall **268** is formed on the opposite edge of the second finger **262** from the second separating wall **266**. The third separating wall **268** intersects with the interior wall of the inner plate **158** defining the massage aperture **252** and the second ring wall **246**. In this manner, the third separating wall **268** fluidly separates the second portion **272** of the second finger **262** from the second flow path **250**.

The back plate **146** for the showerhead **100** will now be discussed in more detail. FIGS. **8**A and **8**B are top and bottom views of the back plate **146**. With reference to FIGS. **8**A and **8**B, the back plate **146** has a back side **276** and a front side **278**. A perimeter wall **296** extends outward and at an angle from the back side **276** and then transitions to a cylindrical form to extend normal to the front side **278**. In embodiments where the perimeter wall **296** is angled, the back side **276** of the back plate **146** may have a frustum or partially conical shape (see FIGS. **2** and **8**A). The back plate **146** may include a plurality of tabs **280** extending outward and spaced apart from one another on the outer surface of the perimeter wall **296**. The configuration of the back plate may be modified based on the connection to the spray head as will be discussed in more detail below.

With reference to FIG. **8**A, a locking band **282** is formed on the back side **276** of the back plate **146**. The locking band **282** includes a plurality of locking fingers **318**. The locking fingers **318** are spatially separated from each other and are configured to act as fasteners to connect the back plate to the mounting plate **144**, as will be discussed in more detail below. The locking fingers **318** are separated from one another so that they will be more flexible than a solid band of material so as to allow the fingers **318** to flex and resiliently return to an initial position. The locking fingers **318** may include lips **320** (see FIG. **4**) extending from a front sidewall. The locking band **282** is defined in a generally circular shape on the back side **276**.

With continued reference to FIG. **8**A, the back plate **146** may also include a plurality of detent recess **292** defined on the back side **276**. In one embodiment, there may be seven detent recess **292**, however, the number of recesses **292** may be based on a desired number of modes for the showerhead **100**. Thus, as the number of modes varies, so may the number of detent recesses **292**. The back plate **146** may also include a stop bump **294** extending upward from the back side **276**. The stop bump **294** may be somewhat trapezoidal-shaped with a curved interior surface facing the center of the back plate **146**.

With continued reference to FIG. **8**A, the back plate **146** includes a plurality of mode apertures **284**, **286**, **288**, **290**. The mode apertures **284**, **286**, **288**, **290** are somewhat triangularly shaped apertures and are positioned adjacent one another. Each of the apertures **284**, **286**, **288**, **290** may correspond to one or more modes of the showerhead **100**, as will be discussed below. In some embodiments, the mode apertures **284**, **286**, **288**, **290** may include a plurality of support ribs **322** extending lengthwise across each aperture to form groups of apertures.

With reference to FIG. **8**B, the back plate **146** may include a plurality of ring walls **298 300**, **302** extending outward from the front side **278**. Similar to the other plates of the showerhead, the ring walls **298**, **300**, **302** of the back plate **146** may be generally concentrically aligned and may have decreasing diameters, where combinations of ring walls define flow paths for the back plate **146**. In particular, the outer perimeter wall **296** and the first ring wall **298** define a first flow path **310**, the first ring wall **298** and the second ring wall **300** define a second flow path **312**, the second ring wall **300** and the third ring wall **302** define a third flow path **314**, and the third ring wall **302** defines a forth flow path **316**.

Similar to the inner plate **158**, the back plate **146** may include a plurality of separating walls **304**, **306**, **308** that fluidly separate the flow paths **310**, **312**, **314** from one another. In one embodiment, the back plate **146** may include a first separating wall **304** that intersects with the first ring wall **298** to fluidly separate the first flow path **310** from the second flow path **312**, a second separating wall **306** intersects the second and third ring walls **300**, **302** to separate the second flow path **312** from the third flow path **314**, and a third separating wall **308** that intersects the second and third ring walls **300**, **302** to separate the froth flow path **316** from the other flow paths. In this embodiment, the third ring wall **302** may transition into a separating wall **324** that functions to separate the fourth flow path **316** from the first flow path **310**. The separating walls **304**, **306**, **308**, **324** are configured to separate each of the mode apertures **284**, **286**, **288**, **290** accordingly the thickness of the separating walls **304**, **306**, **308**, **324** may be determined in part by the separation distance between each of the mode apertures **284**, **286**, **288**, **290**.

A mounting plate **144** connects the engine **126** to the showerhead **100**. FIGS. **9**A and **9**B illustrate top and bottom views of the mounting plate **144**. With reference to FIGS. **9**A and **9**B, the mounting plate **144** may include a top face **326** and a bottom face **328**. A brim **330** extends outward from a terminal bottom edge of the **1**top face **326**. The brim **330** has a larger diameter than the top face **326** and may be substantially planar. A plurality of braces **332** extend upward Sat an angle between at sidewall of the top face **326** and the brim **330** to provide support for the top face **326** of the mounting plate **144**.

With reference to FIG. **9**A, the mounting plate **144** may include an oval shaped engagement wall **338** extending upward from the top face **326**. The engagement wall **338** extends across a width of the top face **326**. Two parallel sidewalls **340**, **342** are positioned within the engagement wall **338** along the longitudinal sides of the engagement wall **338**. The sidewalls **340**, **342** are parallel to each other and a spaced apart from the interior surface of the engagement wall **338**. An engine inlet **336** is defined as an aperture through the top face **326** of the mounting plate **144**. The engine inlet **336** is defined at one end of the engagement wall **338** and is surrounded by the engagement wall **338**. The mounting plate **144** may further include a plurality of fastening apertures **334** defined at various positions on the top face **326**.

With reference to FIG. **9**B, the mounting plate **144** may include a seal cavity **350** defined by walls extending upward from the bottom face **328**. The seal cavity **350** may have a somewhat trapezoidal shape but with one of the walls being slightly curved. The engine inlet **336** is located within the seal cavity **350**. The mounting plate **144** may also include two spring columns **346**, **348** extending downward from the bottom face **328**. The spring columns **346**, **348** are positioned on opposite sides of the engine inlet **336** and may be formed on a bottom surface of the two parallel sidewalls **340**, **342** on the top end of the mounting plate **144**.

With continued reference to FIG. **9**B, the mounting plate **144** may further include a stop cavity **344** defined as a semi-circular cavity in the central region of the bottom face **328**. The stop cavity **344** may be configured to correspond to the shape and of the stop bump **294** of the back plate **146** to allow the stop bump **294** to be received therein. A detent pin cavity **342** is defined on an opposite side of the bottom face **328** from the seal cavity **350**. The detent pin cavity **342** may be a generally cylindrically-shaped volume.

The massage mode assembly **152** will now be discussed in more detail. FIG. **10** is a top perspective view of the massage mode assembly **152**. FIG. **11** is a cross-sectional view of the massage mode assembly **152** taken along line **11**-**11** in FIG. **10**. FIG. **12** is a bottom isometric view of the massage mode assembly **152** of FIG. **10**. With reference to FIGS. **2**, **10**, and **11**, the massage mode assembly **152** may include a jet plate **164**, a pin **168**, a turbine **166**, and a shutter **170**. Each of these components will be discussed in turn below.

The jet plate **164** forms a top end of the massage mode assembly **152** and may be a generally planar disc having a plurality of inlet jets **354**, **356**, **358**. The inlet jets **354**, **356**, **358** are raised protrusions that extend upward and at an angle from the top surface **352** of the jet plate **164**. Each inlet jet **354**, **356**, **358** includes an inlet aperture **366** providing fluid communication through the jet plate **164**. A plurality of pressure apertures **362** may be defined through the jet plate **164** and spaced apart from the inlet jets **354**, **356**, **358**.

With reference to FIGS. **10** and **11**, the jet plate **164** may also include an anchor column **360** extending upward from the top surface **352**. The anchor column **360** may be at least partially hollow to define a cavity configured to receive the pin **168** (see FIG. **11**). Additionally, the jet plate **164** may include a rim **364** extending upward from the top surface **352** along the outer perimeter edge of the top surface **352**.

The turbine **166** of the massage mode assembly **152** will now be discussed. FIGS. **13**A and **13**B are various views of the turbine. The turbine **166** may be a generally hollow open-ended cylinder having blades **368** extending radially inward toward a central hub **378** from a generally circular turbine wall **380**. The turbine wall **380**, or portions thereof, may be omitted in some embodiments. Additionally, although eight blades **368** have been illustrated, the turbine **166** may include fewer or more blades **368**. The turbine **166** may include a pin-shaped extrusion **374** extending generally through the hub **378**. The pin shaped extrusion **374** may extend slightly upward from the upper side of the turbine **166** and downward from the lower side of the turbine **166**. A pin aperture **376** is defined longitudinally through the pin-shaped extrusion **374** and has a diameter corresponding to a diameter of the pin **168**.

The turbine **166** may also include an eccentric cam **372** on its lower side (i.e., the downstream side of the turbine **166**). The cam **372** is positioned off-center from the hub **378** and is formed integrally with the turbine **166**. In one embodiment, the cam **372** includes a cylindrically shaped disc that is offset from the center of the turbine **166**. In other embodiments, the cam **372** may be otherwise configured and may be a separate component connected to or otherwise secured to the turbine **166**. (See, e.g., FIG. **31** illustrating alternative examples of the cam and turbine structure).

With reference to FIG. **12**, the shutter **170** will now be discussed in more detail. The shutter **170** or shoe includes a shutter body **382** having a cam aperture **384** defined therethrough. The shutter body **382** is a solid section of material (other than the cam aperture **384**), which allows the shutter **170** to selectively block fluid flow to outlets when positioned above those outlets. The cam aperture **384** may be a generally oval-shaped aperture defined by an interior sidewall **386** of the shutter body **382**. The width of the cam aperture **384** is selected to substantially match the diameter of the cam **372** of the turbine **166**. However, the length of the cam aperture **384** is longer than the diameter of the cam **372**.

With continued reference to FIG. **12**, the shutter **170** may be a substantially planar disc having a generally oval shaped body **382** but with two parallel constraining edges **388**, **390** formed on opposing ends. In particular, the shutter body **382** may have two relatively straight constraining edges **388**, **390** formed at opposite ends from one another and two curved edges **392** formed on opposite sides from one another. In one embodiment, the curved ends **392** form the longitudinal edges for the shutter body **382** and the constraining edges **388**, **390** form the lateral edges. However, in other embodiments, the shutter **170** may be otherwise configured.

As briefly mentioned above with respect to FIG. **2**, the showerhead **100** may also include a mist plug ring **156**. The mist plug ring **156** creates a mist output from the showerhead **100** nozzles, in particular the second nozzle group **112**. With reference to FIGS. **2** and **14**, the mist plug ring **156** may include a plurality of mist plugs **418** interconnected together on a ring **420**. There may be a mist plug **418** for every mist outlet **422** in the second nozzle group **112**. The mist plugs **418** may have a "Z" shape configured to seat against some portions of the sidewall of the mist nozzle chamber **226**, but not fill the entire chamber **226**. In particular, the stepped or notched edges on either side of the mist plugs **418** provide a gap between the sidewall of the chamber **226** and the plug **418** to allow water to flow into the chamber **226** and through the outlet **422**. As will be discussed in more detail below, the mist plugs **418** create a varying fluid flow within the mist chamber **226** that creates a misting characteristic for the water outflow.

In some embodiments, the variation in geometry within the mist chambers **226** caused by the shape of the mist plugs **418** may be achieved by varying the geometry the mist chambers **226** themselves. That is, the mist chambers **226** can be modified so that the chambers **226** includes a geometry that changes one or more characteristics of the fluid flow through the chamber, such as inducing a spin, to create a desired output characteristic for the water. However, it should be noted that in embodiments where the variation in the geometry of the mist chambers **226** is created due to the inserted mist plug ring **156**, the showerhead **100** may be manufactured at less cost than in instances where the geometry change is done by varying the chamber itself.

The mode selection assembly **408** will now be discussed in more detail. FIG. **15** is an enlarged view of a portion of the exploded view of FIG. **2** illustrating the mode selection assembly **408**. With reference to FIG. **15**, the mode selection assembly **408** may include biasing members **134**, **136**, a seal support **138**, and a mode seal **128**. The mode seal **128** is shaped to correspond to the seal cavity **350** in the mounting plate **144** and is configured to seal against the top surface of the back plate **146**, which allows a user to selectively direct fluid flow form the handle to a particular set or group of nozzles of the showerhead **100**. For example the mode seal **128** may be a sealing material, such as rubber or another elastomer, and may include a mode select aperture **410** define therethrough. In this manner, the mode seal **128** can be aligned with a particular mode aperture to fluidly connect the handle **102** to the engine **128** and to a particular mode aperture within the engine **128**, while sealing the other mode apertures into the engine **128**. In some embodiments, the mode select aperture **410** may be configured to substantially match the configuration of the mode apertures **284**, **286**, **288**, **290** and so may include a plurality of support ribs **412** spanning across the width of the aperture **410**. However, in other embodiments the ribs **412** may be omitted. The mode seal **128** may also include first and second spring columns **414**, **416** extending upward from a top surface thereof.

The seal support **138** provides additional rigidity and structure to the mode selection assembly **408**, in particular, to the mode seal **128**. The seal support **138** may be, for example, a rigid material such as plastic, metal, or the like. The structure provided by the seal support **138** assists the seal **128** in maintaining a sealed relationship with the back plate **146** when under water pressure. In some embodiments, the seal support **138** may substantially match the configurations of the mode seal **128** and may include apertures for the spring columns **414**, **416** and mode select aperture **410**. Although the seal support **138** is shown as a separate component from the mode seal **128**, in other embodiments, the seal support **138** may be integrated to the structure of the mode seal **128**.

Assembly of the Showerhead

With reference to FIGS. **2** and **4**, assembly of the showerhead **100** will now be discussed in more detail. At a high level the engine **126** is assembled and then connected to the spray head **104** as will be discussed in more detail below. To assemble the engine **126**, the massage mode assembly **152** is assembled and then the flow directing plates, i.e., the front plate **148**, the inner plate **146**, and the back plate **146**, are connected together with the nozzle ring **154** and mist ring **156** connected to the respective plates. In particular, with reference to FIG. **11**, the pin **168** of the massage assembly **152** is received into the corresponding aperture in the anchor column **360** of the jet plate **164**. The pin-shaped extrusion **374** of the turbine **166** is then slid around the pin **168**. The turbine **166** is oriented so that the cam **372** is located on the opposite side of the turbine **166** that faces the jet plate **164**. With the turbine **166** and jet plate **164** connected via the pin **168**, the shutter **170** is connected to the turbine **166**. Specifically, the cam **372** of the turbine is positioned within the cam aperture **384** of the shutter **170**.

Once the massage mode assembly **152** has been constructed, the massage mode assembly **152** is connected to the face plate **148** and is received within the massage chamber **220**. With reference to FIGS. **2**, **4**, **6**B, and **11**, the pin **168** is positioned within the pin recess **224** on the shelf **228** of the face plate **148**. The shutter **170** is oriented such that the constraining edges **388**, **390** are parallel to the curb walls **222** of the face plate **148**. The curved walls **392**, **394** of the shutter **170** align with the curved walls of the massage chamber **220**. As shown in FIG. **4**, the turbine **166** is received within the massage chamber **220** so as to be positioned below a top edge of the annular wall **236** of the massage chamber **220** and the bottom edge of the jet plate **164** seats on top of the annular wall **236**. The annular wall **236** supports the jet plate **164** and prevents the jet plate **164** from frictionally engaging the top of the turbine **166** to help ensure that the turbine **166** has clearance from the jet plate **164** to allow the turbine **166** to rotate without experiencing frictional losses from engagement of the jet plate **164**. The spacing gap between the turbine **66** and the jet plate **164**, as determined by the height of the annular wall **236**, may be varied as desired.

In the embodiment shown in FIG. **4**, the turbine inlets **354**, **356**, **358** are on a top surface of the jet plate **164** so that the inlets **354**, **356**, **358** do not interfere with the motion of the turbine **166**. However, in other embodiments, the inlets **354**, **356**, **358** may be positioned on a bottom surface of the jet plate **164** and the turbine **166** may be spaced a greater distance away from the jet plate **164** than as shown in FIG. **4** so as to allow further clearance between the top of the turbine **166** and the turbine jet inlets **354**, **356**, **358**. It should be noted that the jet plate **164** may be press fit against the sidewalls of the third ring wall **234** so that the jet plate **164** is secured in position and the jet plate **164** helps to secure the pin **168** in position within the pin recess **224**. This configuration secures the massage mode assembly **152** to the facet plate **148**, while still allowing the turbine **166** to rotate within the massage chamber **220**.

With reference to FIGS. **4**, **6**B, and **14**, once the massage mode assembly **152** is positioned within the massage chamber **220**, the mist plug ring **156** is connected to the face plate **148**. In one embodiment, the mist plugs **398** are received in the respective nozzle chambers **226**, with the bottom end of each mist plug **398** raised above the shelf **228** surround the nozzle outlet **396**. As discussed above with respect to FIG. **14**, the mist plugs **398** are configured so that water can flow around the mist plugs **398** and into the chamber **226** and out through the mist outlets **396** as will be discussed in more detail below.

In some embodiments the mist plugs **398** may be interconnected together by the ring **420** of webbing. In these embodiments, the mist plugs **398** may be easier to handle and assemble than if they were individual plugs that were not interconnected. For example, a user assembling the showerhead **100** can pick up the ring **420**, which may be easier to handle than the individual plugs **398**, and then press fit each plug **398** into its respective chamber **226**. The webbing forming the interconnections between the mist plugs **398** in the ring **420** may also rest on the upper rims of each of the chambers **226**. The length of the mist plugs **398** below the webbing of the ring **420** may not be as long as the depth of the chambers **226**. The bottoms of the mist plugs **398** are thereby spaced apart from the shelf **228** in each of the chambers **226**.

After the mist plug ring **156** is connected to the face plate **148**, the inner plate **158** may be connected to the face plate **148**. With reference to FIGS. **4**, **6**B-**7**B, the inner plate **158** is coaxially aligned with the face plate **148** and the massage aperture **252** is positioned over the massage chamber **220** so as to allow fluid communication to the massage chamber **220** although the inner plate **158** is positioned above the face plate **148**.

The front surface **238** of the inner plate **158** is aligned so as to face the back surface **194** of the face plate **148**. The outer wall **242** of the inner plate **158** sits on top of the first ring wall **230** of the face plate **148** and the first ring wall **244** of the inner plate **158** sits on top of engages the second ring wall **232** of the face plate **148**. The engagement between the outer wall **242** and first ring wall **244** of the inner plate **158** with the first ring wall **230** and second ring wall **232**, respectively, of the face plate **148** defines a second fluid channel **398** (see FIG. **4**). That is, the engagement of the walls of the face plate **148** and inner plate **158** fluidly connects the first flow path **248** of the inner plate **158** and the second flow path **214** of the face plate **148** to define the fluid channel **398** within the showerhead **100**.

Similarly, the first ring wall **244** and the second ring wall **246** of the inner plate **158** engage with the second ring wall **232** and third ring wall **234** of the face plate **148** to define a third fluid channel **400**, which is formed by the second flow path **250** of the inner plate and the third flow path **216** of the face plate **148**.

The two fingers **260**, **262** of the inner plate **158** jut out over the massage chamber **220** and the massage mode assembly **152**. However, due to the separating walls **264**, **266**, **268**, fluid can be selectively distributed to one or more fluid channels either individually or in combination with one another, as discussed in more detail below.

With reference to FIGS. **4**, **6**A-**8**B, once the inner plate **158** has been aligned with and connected to the face plate **148**, the back plate **146** is connected to the inner plate **158** and face plate **148**. In particular, the perimeter wall **296** of the back plate **146** is aligned with perimeter wall **206** of the face plate **148** so as to engage one another. In this manner, the back plate **146** may be configured so that the back side **276** will be positioned above stream from the front side **278** of the back plate **146**.

The first ring wall **298** of the back plate **146** engages the top surface of the outer wall **242** of the inner plate **158**. Thus, the combination of the back plate **146**, the inner plate **158**, and the front plate **148** defines a first fluid channel **396** (see FIG. **4**). Additionally, the second ring wall **300** of the back plate **146** engages the first ring wall **244** of the inner plate **158** to define an upper second mode channel **404** (see FIG. **4**). As will be discussed in more detail below, the first apertures **254** of the first flow path **248** of the inner plate **158** fluidly connect the upper second mode channel **404** to the second mode channel **398** defined by the face plate **148** and the inner plate **158**.

With continued reference to FIGS. **4**, **6**A-**8**B, the third ring wall **302** of the back plate **146** engages the second ring wall **246** of the inner plate **158** so that the engagement of the first and second ring walls **244**, **246** of the inner plate **158** with the second and third ring walls **300**, **302**, respectively, of the back plate **146** define an upper third mode channel **406**. The upper third mode channel **406** is fluidly connected to the third mode channel **400** via the second set of apertures **256** of the inner plate **158**, as will be discussed in more detail below.

The second ring wall **246** of the inner plate **158** and the third ring wall **302** of the back plate **146** define the forth mode channel **402** (see FIG. **4**). The fourth mode channel **402** is fluidly connected to the massage mode assembly **152**.

The separating walls **264**, **266**, **268** of the inner plate **158** engage with the respective separating walls **304**, **306**, **308** of the back plate **146** to define the various distribution channels for each mode of the showerhead. For example, separating wall **268** of the inner plate **158** engages with separating wall **306** of the back plate **146**, separating wall **264** of the inner plate **158** engages with separating wall **304** of the back plate **146**, and separating wall **266** of the inner plate **158** engages with separating wall **308** of the back plate **146**.

Due to the engagement between the inner plate **158** and the back plate **146**, the first mode aperture **284** is fluidly connected to the fourth mode channel **404**, the second mode aperture **286** is fluidly connected to the first mode channel **396**, the third mode aperture **288** is fluidly connected to the fourth mode channel **402**, and the fourth mode aperture **290** is fluidly connected to the upper third mode channel **406**. In this example, the first mode aperture **284** corresponds to a mist mode, the second mode aperture **286** corresponds to a full body mode, the third mode aperture **288** corresponds to a massage mode, and the fourth mode aperture corresponds to a focused spray mode. However, the above mode examples are meant as illustrative only and the types of modes, as well as the correspondence between particular mode apertures may be varied as desired.

The face plate **148**, inner plate **158**, and the back plate **146** may be connected together once assembled. For example, the plates **146**, **148**, **158** may be fused such as through ultrasonic welding, heating, adhesive, or other techniques that secure the plates together. Once secured, the face plate **148**, inner plate **158**, and back plate **146**, along with the massage mode assembly **408**, form the engine **126** of the showerhead **100**. This allows the engine **126** to be connected to the spray head **104** as a single component, rather than individually attaching each of the plates. Additionally, the connection between each of the plates may be substantially leak proof such that water flowing through each of the channels within plates is prevented from leaking into other channels.

Once the back plate **146** is connected to the inner plate **158**, the mounting plate **144** and the mode selection assembly **408** may be connected to the back plate **146**. With reference to FIGS. **2**, **4**, **8**A, **9**A-**9**B, and **15**, the first and second biasing members **134**, **136** are received around the first and second spring columns **346**, **348**, respectively, of the mounting plate **144**. The biasing members **134**, **136** are then received through the corresponding biasing apertures in the seal support **138**. The mode seal **128** is then connected to the biasing members **134**, **136** as the biasing members **134**, **136** are received around the spring columns **414**, **416** of the mode seal **128**. The mode seal **128** is then positioned within the seal cavity **350** of the mounting plate **144**.

In embodiments where the showerhead **100** includes a feedback feature, the spring **140** is received around a portion of the plunger **142** and the plunger and spring are received into the detent pin cavity **342** of the mounting plate **144**. The spring **140** is configured to bias the plunger **142** against the back side **276** of the back plate **146**.

After the mode selection assembly **408** and the plunger **142** and spring **140** are connected to the mounting plate **144**, the mounting plate **144** is connected to the spray head **104**. An O-ring **150** is received around the outer surface of the engagement wall **338** of the mounting plate **144**. The fasteners **132***a*, **132***b*, **132***c*, **132***d* are then received through the fastening apertures **334** in the mounting plate **144** and secure into corresponding fastening posts (not shown) extending from a surface within the spray head **104** and/or handle **102**. The fasteners **132***a*, **132***b*, **132***c*, **132***d* secure the mounting plate **144** to the showerhead **100**.

Once the mounting plate **144** is connected to the spray head **104**, the engine **126** may be connected to the mounting plate **144**. In particular, the brim **330** of the mounting plate **144** is received within the locking band **282** and the fingers **318** flex to allow the brim **330** to be positioned within the locking band **282** and then snap-fit around the edge of the brim **330**. The lips **320** on each of the fingers **318** extend over a portion of the brim **330** (see FIG. **4**) to grip the brim **330**. Because the engine **126** is secured together as a single component, the engine **126** can be quickly attached and detached from the spray head **104** by snap-fit connection to the mounting plate **144**. It should be noted that the fingers **318** may allow the engine **126** to rotate relative to the mounting plate **144**, so as to allow the user to selectively change the mode of the showerhead **100**. However, the lips **320** prevent the engine **126** from separating from the mounting plate **144**, even under water pressure.

With reference to FIGS. **2**, **4**, and **5**, once the engine **126** is connected to the mounting plate **144**, the nozzle ring **154** is received into the cover **150** and the individual rubber nozzles are inserted into respective nozzle apertures **178**. In some embodiments only certain modes may include rubber nozzles and in these embodiments, the nozzle ring **154** may correspond to a particular mode. However, in other embodiments, every mode may have rubber nozzles and/or may be associated with the nozzle ring. In embodiments where the nozzles are formed through the rubber nozzle ring **154**, the nozzles may be more easily cleaned. For example, during use, the nozzles may be become clogged with sediment or calcification of elements from the water supply source. With rubber nozzles, the nozzles can be deformed or bent to break up the deposits and which are flushed out of the nozzles, whereas with non-flexible nozzles, the nozzles may have to be soaked in a chemical cleaning fluid or cleaned through another time consuming process.

With reference to FIGS. **2**, and **4-6**B, the cover **150** may be secured to the engine **126**. In particular, the face plate **148** is positioned within the cover chamber **170** with the respective nozzle groups aligning with the respective nozzle apertures in the cover **150**. The alignment brackets **174** are connected to the face plate **148** as the locking tabs **208**, **210** are received through the bracket apertures **176** in the cover **150**. The locking tabs **208**, **210** connect the engine **126** to the cover **150** so that as the cover **150** is rotated, the engine **126** will rotate correspondingly. For example, as a user turns the mode selector **118**, the alignment brackets **174** will engage the tabs **208**, **210** to move the engine **126** along with the cover **150**.

With reference to FIGS. **2** and **3**, the regulator **160** and filter **162** may be received at the threaded end of the handle **106** and secured to the handle **102**. Once the cover **150** is secured to the engine **126** (and thereby to the spray head **104**), and the filter **162** and regulator **160** (if included) are connected, the showerhead **100** is ready to be connected to a water supply, e.g., J-pipe or other fluid source, and be used.

Operation of the Showerhead

The operation of the showerhead **100** will now be discussed in more detail. With reference to FIGS. **2-4**, water enters the showerhead **100** through the inlet **108** in the handle **102** or, in instances when the showerhead **100** is a fixed or wall mount showerhead, directly through an inlet to the spray head **104**. As the water enters, the water travels through the inlet conduit **172** to the spray head chamber **175**. The spray head chamber **175** is fluidly connected to the engine inlet **336** in the mounting plate **144**. The fluid flows through the engine inlet **336** and through the mode select aperture **410** of the mode seal **128** that is aligned with the engine inlet **336**. The fluid path of the water after it flows through the mode select aperture **410** depends on the alignment of the engine **126**, in particular the back plate **146**, with the mode selection assembly **408**.

For example, during a first mode, such as a fully body spray mode, the mode seal **128** may be aligned such that the mode select aperture **410** is positioned directly over the second mode aperture **286** of the back plate **146**. Fluid flows through the mode select aperture **410**, through the second mode aperture **286** and into the first mode channel **396**. The sealing material of the mode seal **128** prevents fluid from flowing into other mode channel apertures. From the first mode channel **396**, the fluid exits through the outlets **200** in the face plate **148** and into the rubber nozzles of the nozzle ring **154** and out through the cover **150**.

During a second mode, such as a mist mode, the engine **126** is rotated via the mode selector **118** to a position where the mode seal **128** is aligned with the first mode aperture **284**. In this example, the mode select aperture **410** of the mode seal **128** is aligned directly with the first mode aperture **284** to fluidly connect the spray head chamber **175** with the upper second mode channel **404**. As water flows into the upper second mode channel **404**, the water flows through first apertures **254** in the inner plate **158** into the second mode channel **398**. From the second mode channel **398**, the fluid flows around the mist plugs **418** into the nozzle chamber **226**. The shape of the mist plugs **418** causes the water to spin, prior to exiting the mist outlets **422**. The spinning of the water causes a misting spray characteristic where the water appears as a fine mist and the droplets are reduced in size.

During a third mode, such as a focused spray, the engine **126** is rotated so that the mode select aperture **410** of the mode seal **128** is aligned with the fourth mode aperture **290**. In this example, the fluid flows from the spray head chamber **175** through the fourth mode aperture **290** into the upper third mode channel **406**. The fluid flows into the third mode channel **400** by flowing through the second apertures **256** in the inner plate **158**. Once in the third mode channel **400**, the fluid exits the showerhead through the second group of nozzles **114** of the face plate **148**.

During a fourth mode, such as a massage mode, the engine **126** is rotated so that the mode select aperture **410** of the mode seal **128** is aligned with the third mode aperture **288** of the back plate **146**. Fluid flows from the spray head chamber **175** into the fourth mode channel **402**. Once in the fourth mode channel **402**, the fluid impacts the jet plate **164**. With reference to FIGS. **4**, **10**, and **11**, as the water impacts the jet plate **164**, the water enters the inlet apertures **366** and optionally the pressure apertures **362**. As the water flows through the inlet apertures **366**, it impacts the blades **368** of the turbine **166**. As the water hits the blades **368** of the turbine **166**, the turbine **166** spins around the pin **168**, which is secured to the face plate **148**.

FIG. **16**A is an enlarged cross-section view of the showerhead **100** illustrating the shutter **170** in a first position. FIG. **16**B is an enlarged cross-section view of the showerhead illustrating the shutter **170** in a second position. With reference to FIGS. **4**, **10-12**, and **16A-16**B, as the turbine **166** rotates, the cam **372** moves correspondingly. As the cam **372** is rotated, the cam **372** abuts against the interior sidewall **386** of the shutter **170** and moves the shutter **170**. Due to the eccentricity of the cam **372**, the shutter **170** moves around a center axis of the turbine **166**. However, the movement of the shutter **170** is constrained by the curb walls **222** as they engage the constraining edges **388** of the shutter **170**. As such, as the cam rotates **372** the shutter **170** is moved substantially linearly across the massage chamber **220** in a reciprocating pattern. In particular, the curb walls **222** restrict the motion of the shutter **170** to a substantially linear pathway.

For example, as shown in FIG. **16**A, as the cam **372** rotates in the R direction, the shutter **170** moves in the linear movement M direction across the massage chamber **220**. In this position, fluid flows from the jet plate **164** through the open spaces between each of the turbine blades **368**, past the shutter **170** to the first nozzle bank **120**. Due to the substantially linear motion of the shutter **170**, each of the massage outlets **198** in the first bank **120** open substantially simultaneously. Water exits the face plate **148** through the first bank **120** at substantially the same time.

With reference to FIG. **16**B, as the turbine **166** continues to rotate, the cam **372** continues to move in the R direction, which causes the shutter **170** (due to the curb walls **222**) to move substantially in the linear movement direction M, but toward the opposite sidewall of the massage chamber **220**. As the shutter **170** moves to the second position, each of the nozzles of the first bank **120** are covered at substantially the same time and each of the nozzles of the second bank **122** are uncovered or opened at substantially the same time. This causes the water flow through each outlet **198** in a particular nozzle bank **120**, **122** to start and stop simultaneously, creating a "hammer" or more forceful effect. That is, rather than the outlets **198** in a particular nozzle bank **120**, **122** opening and closing progressively, as is done in conventional massage mode showerheads, the nozzle banks **120**, **122** operate in a binary manner where each bank **120**, **122** is either "on" or "off" and in the "on" state every outlet is open and in the "off" state every outlet is closed.

The intermittent opening and closing of the outlets in each nozzle bank **120**, **122** creates a massaging spray characteristic. In particular, the water flows out the first bank **120** and the flows out the second bank **122** and as it impacts a user creates a forceful hammer type effect. The water flow is instantly started and stopped, which creates a more powerful massaging effect. The binary effect allows the massage force to feel more powerful, which allows the showerhead **100** to use a reduced water flow rate and still produce a massaging experience that replicates showerheads with an increased water flow rate.

As briefly described above, the user can selectively change the mode of the showerhead **100** by rotating the mode selector **118**. With reference to FIG. **4**, as the user rotates the mode selector **118**, the cover **150** engages the tabs **208** on the face plate **148** and rotates the engine **126** therewith. As the engine **126** rotates within the spray head **104**, the back plate **146** rotates relative to the mode seal **128** and plunger **142**.

As the back plate rotates **146**, the force of the user overcomes the spring force exerted by the spring **140** on the plunger **142** and the biasing members **134**, **136** to move the back plate **146**. As the user rotates the mode selector **118**, the plunger **142** compresses the spring **140** and disengages from a first detent recess **292**. When the back plate **146** has been sufficiently rotated to reach a second detent recess **292**, the spring **140** biases the plunger **142** into the detent recess **292**. This allows a user to receive feedback, both haptically and optionally through a clicking or mechanical engagement sound, so that the user will know that he or she has activated another mode. In one embodiment, as will be discussed below, the mode seal **128** may be positioned to span across two mode apertures **284**, **286**, **288**, **290** so that two modes of the showerhead **100** may be activated at the same time. In this embodiment, the back plate **146** may include a detent recess **292** for every separate mode and every combination mode, i.e., for four discrete modes there may be seven detent recesses. However, in other embodiments, the combination modes may not have detents associated therewith and/or there may be fewer or more detents and modes for the showerhead.

Additionally, as the back plate **146** rotates due to the user's rotation of the mode selector **118**, the mode seal **128** is positioned at various locations along the back plate **146**. The mode seal **128** may directly align with one or more of the mode apertures **284**, **286**, **288**, **290** to activate a single mode. Alternatively, the mode seal **128** may be positioned such that the mode select aperture **410** is fluidly connected to two of the mode apertures **284**, **286**, **288**, **290**. For example, the mode seal **128** may be positioned between two of the apertures so that a portion of each aperture is sealed and a portion is opened. In this configuration, the water may flow through two mode apertures **284**, **286**, **288**, **290** simultaneously, activating two modes of the showerhead **100** at the same time. The combination modes may be limited to the modes having mode apertures **2984**, **286**, **288**, **290** positioned adjacent to one another or, in other embodiments, the seal **128** may be varied or the showerhead may include two or more mode seals which may allow for the showerhead **100** to activate two or more modes that do not have mode apertures adjacent one another.

In an embodiment where the back plate **146** includes the stop bump **294** received into the stop cavity **344** of the mounting plate **144**, the stop bump **294** may rotate within the stop cavity **344** as the user rotates the engine **126**. The stop cavity **344** may be configured to provide a "hard stop" to the user to limit the range that the mode selector **118** can rotate. In particular, the rotation may be determined by the arc length of the stop cavity **344**. As the engine **126** is rotated by the mode selector **118**, the stop bump **294** travels within the cavity **344** until it reaches an end of the cavity **344**. Once the stop bump **294** reaches an end of the cavity **344**, the engagement of the stop bump **294** against the cavity walls prevents the user from further rotating the mode selector **118**. The hard stop helps to prevent damage to the showerhead **100** as a user cannot over-rotate the mode selector **118** past a desired location.

Engine Release and Mode Variation Examples

Alternative examples of the engine release and attachment and mode apertures will now be discussed. FIGS. **17**A-**22**B illustrate another example of a showerhead of the present disclosure having another example of a releasable engine and multiple spray modes of a different configuration than the showerhead of FIGS. **1**A and **1**B. In the below examples, like numbers are used to describe features that are substantially similar to those in the showerhead of FIGS. **1**A and **1**B. Additionally, any features not specifically identified below are the same as or similar to features of the showerhead of FIGS. **1**A and **1**B.

FIGS. **17**A and **17**B are various isometric views of another example of a showerhead of the present disclosure. FIG. **18** is an exploded view of the showerhead of FIGS. **17**A and **17**B. FIG. **19** is a cross-sectional view of the showerhead taken along line **19**-**19** in FIG. **17**B. With reference to FIGS. **17**A-**19**, the showerhead **500** may be substantially the same as the showerhead **100** of FIG. **1**A. However, the showerhead **500** may include another example of an engine release and back plate as compared to the showerhead **100**. In particular, the showerhead **500** may include an engine release assembly **506**. The engine release assembly **506** may be used to selectively secure and release the engine **526** from the spray head **104**. Additionally, the engine **526** may include another example of a back plate **546** and the mounting plate may be omitted in this showerhead example.

FIG. **20**A is a front isometric view of the spray head **104'** and handle **102'** of the showerhead **500**. FIG. **20**B is a rear elevation view of the spray head **104'** and handle. With reference to FIGS. **19**-**20**B, in some examples, the showerhead **500** may include features defined on an interior surface **512** of the spray head **104'** that are similar to elements of the mounting plate **144**. This configuration may allow the mounting plate **144** to be omitted and/or differently configured. For example, with reference to FIG. **20**A the spray head **104'** may include a seal cavity **550** defined by a sealing wall **514** extending downward from the interior surface **512** of the spray head **104'**. The sealing cavity **550** is configured to receive a mode seal **528** and may include a spring column **552** positioned in a center thereof, the spring column **552** being configured to receive one or more biasing members and extending downward from the interior surface **512**.

The spray head **104'** may include a spray head inlet **536** in fluid communication with the inlet **108'** to the handle **102'**. The spray head inlet **536** fluidly connects the sealing cavity **550** to the inlet **108'** of the handle **102'**. In this example, the spray head chamber may be defined by the sealing cavity **550** rather than the entire interior of the spray head **104'**. In other words, the fluid may be channeled directly from the handle **104'** into the sealing cavity **550**.

Additionally, the spray head **104'** may include a detent wall **516** extending downward from the interior surface **512** on an opposite side of a center of the spray head **104'** from the sealing cavity **550**. The detent wall **516** defines a detent cavity **542** configured to receive the plunger **142'** and the spring **140'** for the detent assembly.

As the spray head **104'** itself may include features such as the seal cavity **550** and the detent cavity **542**, which may be substantially similar to the seal cavity **350** and detent cavity **342** on the mounting plate **144** in FIG. **9**B, the mounting plate **144** may be omitted. This allows the engine **526**, and in particular the back plate **546**, to be directly connected to the spray head **104'** rather than through an intermediate component. By omitting the mounting plate **144**, the showerhead **500** may be cheaper to manufacture and faster to assemble than the showerhead **100** of FIG. **1**A.

With reference to FIG. **20**A, in this example, the showerhead **500** may also include two or more positioning tabs **554** extending inward from the interior surface **512** toward a center of the spray head **104'**. The positioning tabs **554** may be connected to the engine **526** to help ensure that the engine **526** remains in the correct position within the spray head **104'**.

With reference to FIG. **20**B, the spray head **104'** may include a cap cavity **536** defined on a back surface of the spray head **104'**. The cap cavity **536** may be configured to receive one or more components of the engine release assembly **506**. Additionally, the cap cavity **536** provides access to the top surface of the back plate **546**, which as discussed in more detail below, may be used to quickly connect and disconnect the engine **526**. In some embodiments, the cap cavity **536** may include one or more keyed features **518**. For example, the keyed feature **518** may be a protrusion such as a curved sidewall that extends into the cap cavity **536** from a sidewall surrounding and defining the cap cavity **536**. In one embodiment, the spray head **104'** may include two keying walls **518** on opposite sides of the cap cavity **536** from one another. The spacing between the two keyed features **518** may be configured based on a desired degree of rotation available to the engine **526** during installation and as such may be modified based on a desired engine rotation within the spray head.

The engine release assembly **506** of the showerhead **500** may include a cap **504**, a fastener **508**, and a keyed washer **510**. FIGS. **21**A and **21**B illustrate bottom and top views, respectively, of the keyed washer **510**. With reference to FIGS. **18**, **21**A, and **21**B, the keyed washer **510** selectively connects to the back plate **546** of the engine **526**. The keyed washer **510** may include a keyed cavity **540** recessed from a bottom surface **568** and the keyed cavity **540** may form a protrusion extending outward from the top surface **570** of the keyed washer **510** (see FIG. **21**B). The keyed cavity **540** may have a varying shape including a plurality of keyed protrusions, angled sidewalls, or other keying elements configured to correspond to a keyed protrusion on the back plate **546**, as will be discussed in more detail below. For example, in the embodiment shown in FIG. **21**A, the keyed cavity **540** may have a five prong shape with the prongs jutting out from a center of the keyed washer **510** and with one of the prongs having a larger width and a curved surface that is differently configured from the other prongs. The center of the keyed washer **510** includes a fastening aperture **520** defined therethrough. It should be noted that the shape and configuration of the keying features of the keying washer **510** shown in FIGS. **21**A and **21**B are meant as illustrative only and many other keying features are envisioned.

The keyed washer **510** may also include an alignment tab **574** extending outward from a sidewall of the washer **510**. The alignment tab **574** may be positioned adjacent the differently configured prong of the keyed cavity **540**. The alignment tab **574** may form another keying feature for the keyed washer **510** that may interface with different components than the components that interface with the keyed cavity **540**.

The engine **526** of the showerhead **500** will now be discussed in more detail. FIGS. **22**A and **22**B illustrate top and bottom plan views, respectively, of the back plate of the engine **526**. With reference to FIGS. **18**, **19**, **22**A, and **22**B, the engine **526** may be substantially similar to the engine **126** but may include a modified back plate **546**. In particular, the back plate **546** may include a keyed protrusion **534** extending from a top surface thereof. In this example, the keyed protrusion **534** may be configured to substantially match the keying cavity **540** of the keying washer **510**. For example, as shown in FIG. **22**A, the keyed protrusion **534** may include a plurality of raised prongs extending outward from a central region with one of the prongs being differently configured than the other four prongs. As with the keying washer **510**, it should be understood that the actual configuration of the keying elements of the keyed protrusion **534** are meant as illustrative only and other keying configurations may be used. The back plate **546** may also include a ledge **538** extending partially around the outer perimeter sidewall.

The back plate **546** may also include a plurality of mode apertures **584**, **586**, **588**, **590** defined through a top surface. The mode apertures **584**, **586**, **588**, **590** may be substantially the same as the mode apertures **284**, **286**, **288**, **290** of the back plate **146**. However, in this example, the mode apertures **584**, **586**, **588**, **590** may be differently shaped. For example, in the back plate **546**, the mode apertures **584**, **586**, **588**, **590** may include generally circular apertures including a support rib extending laterally across each aperture. Additionally, the first mode aperture **584** and the second mode aperture **590** may be slightly smaller than the other remaining apertures or otherwise may be differently configured from the remaining apertures **586**, **588**.

The first mode aperture **584** and the fourth mode aperture **590** may be modified to accommodate two additional mode apertures as compared to the back plate **146**. In this example, the showerhead **500** may include a trickle or pause aperture **530** and a low flow aperture **532**. The trickle aperture **530** may be an aperture defined through the top surface of the back plate **526** that has a substantially reduced diameter as compared to the mode apertures **584**, **586**, **588**, **590**. The smaller diameter of the trickle aperture **530** (as compared to the other apertures) limits the water flow therethrough and may be used to substantially reduce the water flow output by the showerhead **500**. For example, when the showerhead **500** is in the trickle mode such that the mode select aperture **410** of the mode seal **528** is aligned with the trickle aperture **530**, the constricted diameter of the aperture **530** limits the water flow into the engine **526** and thus the water flow that flows out of the nozzles. In one embodiment, the trickle aperture **530** may share the outlet nozzles with the first mode aperture **584**. However, in other embodiments the trickle aperture **530** may have a separate set of nozzles or a specific nozzle that functions as a weep hole to allow the reduced amount of fluid to flow out when the showerhead **500** is in the trickle mode. The trickle aperture **530** and low flow aperture **532** will be discussed in more detail below.

With reference to FIG. **22**B, the back plate **546** may also include a plurality of ring walls **522**, **524** and separating walls **560**, **562**, **564**, **566**. The ring walls **522**, **524** and the separating walls **560**, **562**, **564**, **566** extend downward from an interior or bottom surface of the back plate **546** and are used to fluidly separate flow from each of the mode apertures **584**, **586**, **588**, **590** from one another and define the flow channels when connected to the face plate **148'** as discussed above. The ring walls **522**, **524** and separating walls **560**, **562**, **564**, **566** may be modified based on a desired flow path through the engine **526** but provide the same functionality as the respective walls in the back plate **146** of the showerhead **100**.

As mentioned above, the back plate **546** includes two specialty mode apertures as compared to the back plate **146**. In one example, the back plate **546** includes the trickle aperture **530** and the low flow aperture **532**. These two apertures may be in fluid communication with the same flow paths as the first mode aperture **584** and the fourth mode aperture **590**, respectively, and as such may be in fluid communication with the outlet nozzles of those modes. However, in other embodiments, the trickle aperture **530** and the low flow aperture **532** may have separate outlets or nozzles.

Additionally, the trickle aperture **530** and the low flow aperture **532** may be used in combination with the first mode aperture **584** and the fourth mode aperture **590**, respectively. In other words, the mode seal **528** may be positioned so that both the main mode aperture **584**, **590** and one of the specialty mode apertures **530**, **532** are in fluid communication with the sealing cavity **536** simultaneously. In this example, the mode seal **528** may be configured to allow the mode and specialty apertures to both be fully open simultaneously or may be configured to allow only a portion of each to be opened simultaneously.

The diameter of the trickle aperture **530** may be selected in consideration of the anticipated water pressure from a fluid source, as well as the structural strength of the engine **526** and spray head **104'**. In particular, the stronger the fluid pressure and the weaker the showerhead components the larger the trickle aperture **530** may be. In some embodiments, the trickle mode may correspond to a seal rather than the trickle aperture **530**. For example, depending on the strength of the showerhead components and/or the anticipated water pressure, the showerhead **500** may include a pause mode where the mode select aperture **410** of the mode seal **528** is aligned with another seal or the top surface of the back plate **546**. In this example, the back plate **546** seals the mode select aperture substantially preventing water from flowing into the engine **526**.

Using the trickle aperture **530** or in examples where the showerhead **500** includes a pause mode, the user can substantially reduce or eliminate the water flow out of the showerhead, without having to adjust the water source. For example, the user can change the mode of the showerhead **500** to the trickle mode when he or she is lathering shampoo in his or her hair or doing another activity that does not require water use. Because the water source does not have to be adjusted in order to pause/reduce the flow, the user can quickly reactivate the normal flow through the showerhead **500** and maintain his or her previous temperature settings. This allows a user to have more control of the water flow through the showerhead and save water during bathing without having to adjust the temperature and/or other characteristics of the water supply.

With reference to FIGS. **22**A and **22**B, the low flow aperture **532** may be positioned adjacent the fourth mode aperture **590**. The low flow aperture **532** may be larger than the trickle aperture **530**, but may be smaller than the mode apertures **584**, **586**, **588**, **590**. The low flow aperture **532** is similar to the trickle aperture **530** in that it acts to reduce the flow output by the showerhead **500**, but with an increased water flow rate as compared to the trickle aperture **530**. The low flow aperture **532** may be used in instances where a water supply and/or water usage is monitored or constrained (e.g., septic tank systems), in instances where low flow is desired (e.g., users or locations where an "eco" mode using less water is desired), and/or in instances where the amount of water to be used is desired to be reduced as compared to conventional showerheads but where a user may wish to still shower.

In one example, the trickle mode aperture **530** may correspond to a flow of 0.2-0.5 gallons per minute, the low flow mode aperture may correspond to a flow of 1.0-1.4 gallons per minute, and the regular mode apertures may correspond to a flow between 1.5-2.5 gallons per minute.

With reference to FIGS. **18** and **19**, in some instances, the mode seal **528** may be slightly modified from the mode seal **128**. For example, in the showerhead **500** the mode select aperture **410** may be a single opening without any support ribs extending across width. Additionally, in this example, the mode seal **528** may be generally oval or bean shaped as compared to the somewhat trapezoidal shape of the mode seal **128**. Further, in this example, the mode selection assembly may include a single biasing spring **534** and this spring **534** may be received around the spring column **552** of the spray head **104'**, rather than the spring columns of the mounting plate **144** as in the showerhead **100**.

As briefly mentioned above, the engine **526** of the showerhead **500** may be selectively connected and released from the spray head **104'**. The assembly and disassembly of the showerhead **500** will be discussed in more detail. With reference to FIGS. **17**A-**21**B, the engine **526** may be assembled in substantially the same manner as described above with respect to FIG. **1**A. However, in instances where the engine **526** may not include an inner plate **158** (such as shown in FIG. **19**), the back plate **526** may be connected directly to the face plate **148'** without an intermediate plate. In this example, the massage assembly **152'** may be enclosed within the face plate **148'** and back plate **546**. Once the plates **148'**, **546** of the engine **526** are aligned and connected together as described above, the engine **526** is connected to the spray head **104'**.

In particular, the engine **526** may be axially aligned with the handle **102'** and inserted into the spray head **104'**. In some embodiments the engine **526** may be inserted 180 degrees out of phase from its operational position so that the ledge **538** on the back plate **546** engages with the positioning tabs **554** of the spray head **104'**. Once the ledge **538** engages the positioning tabs **554**, the engine **526** is rotated 180 degrees or until it is in a desired location. When the engine **526** is properly located within the spray head **104'**, the keyed washer **510** is connected to the back plate **546**. The keyed cavity **540** of the washer **510** is aligned with the keyed protrusion **534** on the back plate **546** and connected thereto. The fastener **508** is then received through the fastening aperture **520** in the keying washer **510** and into the fastening cavity **528** defined on the center of the keyed protrusion **534**. The fastener **508** secures the engine **526** to the keyed washer **510**.

Once connected, the alignment tab **574** on the washer **510** is positioned between the two keying walls **518** of the cap cavity **536**. The keying walls **518** and alignment tab **574** help to prevent the engine **526** from rotating 180 degrees when attached to the spray head **104'**, i.e., helps to secure the engine in a desired location. Additionally, the alignment tab **574** and the keying walls **518** define the degrees of rotation available to the engine **526** to allow a user to change the mode such as by turning the mode selector **118'** to rotate the engine **526**. This will be discussed in more detail below.

Once the keying washer **510** and engine **526** are located as desired, the cap **504** is received into the cap cavity **536**. The cap **504** provides an aesthetically pleasing appearance to cover the cap cavity and helps to seal the cavity from fluid and debris. In some embodiments, the cap **504** may be press fit, threaded, or otherwise fastened to the spray head **104'**. After the engine **526** is connected to the spray head **104'**, the cover **150'** is connected to the engine **526** in the same manner as described above with respect to the showerhead **100**.

To disconnect the engine **526** from the spray head **104'**, the cap **504** and fastener **508** are removed and once the cover **150'** is removed, the engine **526** can be removed. This allows the showerhead **500** to be assembled, tested, and if the engine **526** does not function properly the engine **526** can be removed and replaced without damaging the spray head **104'** or the handle **102'** As the spray head **104'** and/or handle **102'** are often the more expensive components of the showerhead **500** due to the fact that often they include plating, chrome, or other aesthetic finishes, by being able to replace defective components within the showerhead **500** without damaging the finished components, the manufacturing process for the showerhead may be cheaper. In other words, rather than throwing out defective showerheads that include expensive components, the showerhead of the present disclosure can be fixed by replacing the defective component, without damaging the finished components. This also may allow the showerhead to be repaired after manufacturing (e.g., after a user has purchased the showerhead) more easily.

During operation, the showerhead **500** may operate in substantially the same manner as the showerhead **100** of FIG. **1**A, with slight changes based on structural differences in some of the components. For example, with reference to FIG. **19**, water flows through the handle **102'** and enters the spray head **104'** through the spray head inlet **536**. Water then flows directly into the seal cavity **550** from the spray head inlet **536** and enters the engine **526** through one or more mode apertures **530**, **532**, **584**, **586**, **588**, **589**. The path of the water through the engine **526** depends on the selected mode(s), after traveling through one or more paths, the water exits through one or more nozzle groups.

To change modes, the user rotates the mode selector **118'**, which due to its engagement to the engine **526** causes the engine **526** to rotate relative to the mode seal **528**. The rotation of the engine **526** is limited by the keying walls **518** in the cap cavity **536**. In particular, as the user rotates the mode selector **118'** the keyed washer **510**, which is secured to the engine **526** via the fastener **508**, rotates therewith. As the keyed washer **510** rotates within the cap cavity **536**, the alignment tab **574** rotates and when it engages against one of the keying walls **518**, acts to prevent further rotation in that direction. In this manner, the alignment tab **574** and the keying walls **518** act as a hard stop to limit the rotation of the engine **526**. This configuration helps to prevent the engine **526** from over-rotating within the spray head and possibly being damaged.

In some embodiments the trickle mode aperture **530** and/or the low flow aperture **532** may be aligned with the mode aperture **410** when the engine **526** is in a choked or over-clocked position. For example, the trickle mode aperture **530** and the low flow aperture **532** may be located at a position on the back plate **546** that does not correspond to the detent recesses **292'** or is otherwise at the extreme ends of the rotational spectrum of the engine **526**. In this manner, the user may have to rotate the engine **526** further (via the mode selector **118'**) than with the other modes. Additionally, in some embodiments, the trickle mode aperture and/or the low flow aperture may be fluidly connected to the fluid inlet when the "normal" mode aperture is connected to the fluid inlet. For example, during the normal mode corresponding to the particular mode aperture adjacent the alternate mode aperture (i.e., trickle mode aperture, low flow aperture), fluid may flow both through the normal mode aperture and the alternate mode aperture. However, in other embodiments, the alternate mode aperture may be sealed during the normal mode.

Fixed Mount Example

As discussed above, in some embodiments the showerhead **600** may be a fixed or wall mount showerhead. In these examples, the showerhead **600** may not include a handle and may be configured to be fixedly secured to a wall or other structural element. FIG. **23** is an isometric view of an example of a fixed mount showerhead **600**. FIG. **24** is a cross-section view of the fixed mount showerhead **600** of FIG. **23** taken along line **24**-**24** in FIG. **23**. With reference to FIGS. **23** and **24**, the fixed mount showerhead **600** may be substantially similar to the showerhead **500** as shown in FIG. **17**A. However, in this embodiment the showerhead **600** may be configured to attach to a structural feature such as a wall or other fixed location. As such, the handle **104'** may be omitted and the spray head **604** may include an attachment assembly for connecting to a fluid source.

In one example, the attachment assembly may include a pivot ball connector **606**. The pivot ball **606** may be similar to the pivot ball connector shown in U.S. Pat. No. 8,371,618 entitled "Hidden Pivot Attachment for Showers and Method of Making the Same," which is hereby incorporated by reference herein in its entirety. The pivot ball **606** is configured to attach to a J-pipe or other fluid source and may include a threaded portion, similar to the threaded portion on the handle **104'**. Additionally, the showerhead **600** may include a collar **610**, split ring **608**, and one or more seals **616** that interface or connect to the pivot ball connector **606**. For example, the collar **610** may be threadingly attached to the spray head **604** and the pivot ball connector **606** may be pivotably received therein. This allows the spray head **604** to be pivoted or rotated about a fixed location so that a user can reposition the showerhead **600** as desired. The split ring **608** and seal **616** assist in securing the pivot connector **606** to the collar **610** and providing a leak-tight connection.

With continued reference to FIGS. **23** and **24**, the spray head **604** of the showerhead **600** includes an inlet aperture **636** defined through a back surface **612** thereof. The inlet aperture **636** may be somewhat similar to the cap cavity **536** as it may receive the engine connection assembly components such as the keyed washer **510** and fastener **508**. Additionally, the inlet aperture **636** functions to provide water from the showerheads **600** inlet **108"** to the seal cavity **550**. For example, the spray head **604** may include a fluid passage **605** between the inlet aperture **636** and the seal cavity **550**. The fluid passage **605** fluidly connects the showerhead inlet **108"** to the seal cavity **550**. The fluid passage **605** may be defined by one or more walls extending from an interior surface of the spray head **604** and/or apertures defined within those walls.

In operation, water flows from a fluid source into the showerhead inlet **108"** and through the pivot ball connector **610**. As the water exists the pivot ball connector **606**, the water flows into the spray head inlet aperture **636** and then to the seal cavity **550** via the fluid passage **605**. Once the water reaches the seal cavity **550** it is transmitted to the engine **526** through one or more of the mode apertures as discussed in more detail above.

Massage Mode Assembly Examples

The massage mode assembly **152** may be modified to include different features, components, and/or configurations. FIGS. **25-34** illustrate various examples of alternate massage mode assemblies. In each of the examples described below, the shutter may be activated by the turbine and move in an oscillating or sliding manner to selectively cover and uncover banks of nozzles. As with the massage mode assembly **152** in the above examples, the shutter is configured to cover or uncover all the outlets in a particular nozzle bank at substantially the same time. The below examples have been removed from the showerhead to more clearly illustrate the features of the massage mode assembly configurations. In particular, in the below examples the massage chamber is depicted as a standalone chamber rather than a chamber formed by the combination of one or more plates of the engine. These depictions are not meant as limiting and any of the below examples may be used with the showerheads **100**, **500**, **600** and in particular with the massage chamber **220** shown above. It should be noted that features identified used similar numbers to features described above may the same as or similar to the features in the above examples.

First Example

FIG. **25** is a cross-section view of a first example of the massage mode assembly **152(1)**. FIG. **26**A is another cross-section view of the massage mode assembly **152(1)** of FIG. **25** with the shutter **670** in a first position. FIG. **26**B is a cross-section view of the massage mode assembly **152(1)** as shown in FIG. **26**B but with the shutter **670** in a second position. With reference to FIGS. **25-26**B, in this example, the massage mode assembly **152(1)** may be substantially the same as the massage mode assembly of FIG. **2**. However, in this example, the shutter **670** may be a round disc having a plurality of lobes **672** or shutter teeth extending radially from the main body. The lobes **672** are positioned around the perimeter of the shutter **670**. The diameter of the lobes **672** may be selected to substantially match or be larger than the outlets in the massage chamber **220(1)** so that each lobe **672** can cover an outlet.

Additionally, in this example, the massage chamber **220(1)** may include a plurality of engagement teeth **674** or lobes on a bottom surface. The engagement teeth **674** may be similar to the curb walls in that they may influence the movement of the shutter **670** across the chamber **220(1)**.

As shown in FIGS. **26**A and **26**B, as the shutter **670** is moved by the turbine **166(1)** turning the cam **372(1)** upon water impact from the jet plate **164(1)**, the lobes **672** selectively cover and uncover the banks **120(1)**, **122(1)** of nozzles. In this example, the shutter **670** may be restricted to a single translation degree by lobes **672** on the shutter **670** and in operation with the teeth **674** in the chamber **220(1)**. The engagement of the lobes **672** and the teeth **674** acts to restrict the shutter from rotating while allowing the of sliding motion. In operation, the shutter may move across one set of nozzles while exposing the opposite set of nozzles in a repetitive motion.

Second Example

FIGS. **27-29** illustrate another example of a massage mode assembly. With reference to FIGS. **27-29**, in this example, the massage mode assembly **752** may include a jet plate **764** having a generally cylindrical shape with two apertures **754** defined in the sidewalls of the cylinder body. Additionally, an annular flange **753** extends around an outer surface of the cylindrical body. The turbine **766** in this example includes a plurality of blades and the outer turbine circular wall is omitted. Additionally, the cam **772** is formed as an eccentrically shaped hemispherical body.

The shutter **770** includes a trough shaped-bottom with a cam wall **768** defined on a top surface of the shutter **770** bottom. Additionally, two arms **762** extend upward from the trough on either side thereof. The arms **762** pivotably connect to the jet plate **764** to provide a back and forth swinging motion of the shutter **770**. In other words, the range of the guide arms **762** and the shutter **770** is constrained by the interior walls of the chamber **229(2)** and clearance limitations of the arms **762** in recesses of the jet plate **764** in the massage mode assembly **752**.

Third Example

FIGS. **30-32** illustrate a third example of a massage mode assembly. With reference to FIGS. **30-32**, the massage mode assembly **852** in this example may include an axially oriented turbine **866** positioned between two guide arms **874** of a shutter **870**. In particular, the shutter **870** includes a concaved curved bottom member that functions to selectively cover and uncover the nozzle banks **120(3)**, **122(3)**. The two guide arms **874** extend on opposite sides from one another and are positioned on the longitudinal edges of the shutter body. Each of the guide arms **874** include two apertures. A first aperture is at a top end of the arms and is configured to receive a securing bar or pin **871**. A second aperture **873** forms a cam follower and is configured to receive the cam **872** of the turbine.

As shown in FIG. **32**, the turbine **866** is axially oriented and positioned between the two arms **874**. In this example, the cam **872** extends from both sides of the turbine **866** with one end being received in the cam aperture **873** of the first guide arm **874** and the other end being received in the cam aperture **873** of the second guide arm **874**. In this embodiment the turbine **866** may resemble a water wheel as the water flow causes the blades to move downward rather than in a carousel or lateral rotational movement. Additionally, the pin **168(3)** is lodged in a recess or pocket in the downward extending walls of the jet plate to provide a fixed horizontal rotational axis rather than the vertical rotational axis as shown in the showerhead **100**.

The jet plate **864** may also include two or more apertures (not shown) that are used to secure the shutter **870**, in particular the guide arms **874** of the shutter **870**, to the jet plate **864**. For example, the upper pin **871** may extend laterally across a width of the jet plate **864** and be secured on either side of the jet plate **864** to secure the shutter **870** within the massage chamber **220(3)** and provide a pivot point for the movement of the shutter **870**.

With reference to FIGS. **31** and **32**, as the turbine **866** rotates about the pin **168(3)**, the cam **872** causes the guide arms **874** to move laterally in a swing-type movement, which in turn causes the shutter **870** body to move in the lateral sweeping pattern within the massage chamber **220(3)**.

Fourth Example

In a fourth example, the massage mode assembly may be similar to the third example above, but the guide arms may be separate from the shutter. FIG. **33** is an isometric view of the fourth example of the massage mode assembly. With reference to FIG. **33**, in this example, the massage mode assembly may include a pair of guide arms **880**, **882** that are connected to each other by a pin **871** and connected to a shutter disk **870** by connecting ends **888**. Each guide arm **880**, **882** may include a pin aperture **884** toward a top thereof and a cam aperture **886** toward a center thereof. The cam aperture **886** may have a generally oval shape and the sidewalls of the guide arms **880**, **882** may bulge outward on both sides adjacent the cam aperture **886**. The bulge provides additional strength and rigidity to the guide arms **880**, **882** at the location of the cam aperture **886**. The bottom end of each guide arm **880**, **882** includes a hemispherical protrusion **888** with the straight face of the hemispherical shape oriented downward toward the top surface of the shutter **870**.

With reference to FIG. **33**, in this example the shutter **870** may be a substantially planar disc and may include two sets of securing prongs **878***a*, **878***b* that extend upward from a top surface of the shutter **870**. Each hemispherical protrusion **888** of the guide arms **880**, **882** is received between the respective set of securing prongs **878***a*, **878***b* of the shutter **870** to connect the shutter **870** to the guide arms **880**, **882**. The shutter may also include a plurality of apertures, where depending on the location of the shutter the shutter apertures selectively align with the nozzle outlets to allow fluid to exit the massage chamber.

In operation, the eccentric cams **872** of the turbine drive the disk shaped shutter **870** so that it that oscillates in a rotary fashion through the guide arms **880**, **882**. In this example, the cams **872** attached to the turbine **866** via the pin **168**(**4**) are positioned with their eccentricity opposite each other such that the prescribed motion of each cam is opposite to the motion of the other, the opposite motion of the cams restricts the rotational movement of the shutter. In particular, the shutter spins back and forth selectively aligning the shutter apertures with the nozzle outlets. The back and forth rotation is limited to a few degrees in either rotation direction which quickly and selectively opens and closes the nozzle outlets on either side of the massage chamber. The alternating motion of the shutter blocks one set of nozzles while exposing the opposite set of nozzles in a repetitive motion fashion.

Fifth Example

FIG. **34** is a top perspective view of a fifth example of a massage mode assembly. With reference to FIG. **34**, in this example, the massage mode assembly **952** may include a support bracket **902** including a plurality of nozzles therethrough and a turbine support pin **942** extending upward from a center area, two shutter pins **960***a*, **960***b* positioned on either side of the support pin **942**. The support bracket **902** may form a portion of the face plate **148** for the showerhead or may replace one or more other plates within an engine of the showerhead.

The massage mode assembly **952** may also include two shutter disks **970***a*, **970***b* having a plurality of apertures **958** defined therethrough. Additionally, each of the shutters **970***a*, **970***b* may include a linkage pulley **930**, **932** extending upward from a top surface.

The massage mode assembly **952** may include a turbine **966** having a plurality of blades extending outward form a central hub. The hub may form an eccentric cam **972** for the turbine **966**. Additionally, the massage mode assembly **952** includes two linkage rods **954**, **956**. The rods **954**, **956** may be substantially rigid and be configured to attach to both the turbine **966** and the pulleys **930**, **932** on the shutters **970***a*, **970***b*.

With continued reference to FIG. **37**, the two shutter disks **970***a*, **970***b* are received around the shutter pins **960**, **960***b* on the bracket **920**. The turbine **966** is received around the turbine support pin **942**. A first rod **954** is connected to the first linkage pulley **930** on the first shutter **970***a* and then received around the cam **972** of the turbine **966**. A second rod **956** is connected to the second linkage pulley **932** on the second shutter **970***b* and then also received around the cam **972** of the turbine **966**. In operation, the turbine **966** is driven by water and the shutters **970***a*, **970***b* which are both connected to the single cam **972** are moved correspondingly. In particular, one shutter **970***a* moves across one set of nozzles, blocking the flow through that set of nozzles and the second shutter **970***b* moves to expose a second set of nozzles via alignment of the apertures **958** with the nozzles. As the turbine **966** rotates, the motion of the shutters **970***a*, **970***b* reverses, and the two motions alternately repeat in a continuing sequence to align and displace the apertures **958** on each of the shutters **970***a*, **970***b* with respective sets of nozzles.

CONCLUSION

A showerhead including the pulsating assemblies of examples 1-6 may provide a slower, more distinct pulse, as compared to conventional rotary turbine driven shutters. The flow through the nozzles may have an increased pressure as experienced by the user, as each group of nozzles may be "on" or "off", without a transition between groups. This may allow for the water flow to be directed through only the nozzles in the "open" group, increasing the flow through those nozzles. As an example, the user of a shutter that selectively opens and closes groups of nozzles simultaneously may produce a satisfying massage, even at low water flow rates. Thus, the examples described herein may be used provide a strong feeling "massage mode" for the showerhead, but at a reduced water flow rate, reducing water consumption. Additionally, by aiming the nozzles, or through the physical placement of nozzle groups on the showerhead spatially separated from each other, more distinct individual pulses may be detected by the user, which can result in a more therapeutic massage.

It should be noted that any of the features in the various examples and embodiments provided herein may be interchangeable and/or replaceable with any other example or embodiment. As such, the discussion of any component or element with respect to a particular example or embodiment is meant as illustrative only.

It should be noted that although the various examples discussed herein have been discussed with respect to showerheads, the devices and techniques may be applied in a variety of applications, such as, but not limited to, sink faucets, kitchen and bath accessories, lavages for debridement of wounds, pressure washers that rely on pulsation for cleaning, care washes, lawn sprinklers, and/or toys.

All directional references (e.g., upper, lower, upward, downward, left, right, leftward, rightward, top, bottom, above, below, vertical, horizontal, clockwise, and counterclockwise) are only used for identification purposes to aid the reader's understanding of the examples of the invention, and do not create limitations, particularly as to the position, orientation, or use of the invention unless specifically set forth in the claims. Joinder references (e.g., attached, coupled, connected, joined and the like) are to be construed broadly and may include intermediate members between the connection of elements and relative movement between elements. As such, joinder references do not necessarily infer that two elements are directly connected and in fixed relation to each other.

In some instances, components are described by reference to "ends" having a particular characteristic and/or being connected with another part. However, those skilled in the art will recognize that the present invention is not limited to components which terminate immediately beyond their point of connection with other parts. Thus the term "end" should be broadly interpreted, in a manner that includes areas adjacent rearward, forward of or otherwise near the terminus of a particular element, link, component, part, member or the like. In methodologies directly or indirectly set forth herein, various steps and operations are described in one possible order of operation but those skilled in the art will recognize the steps and operation may be rearranged, replaced or eliminated without necessarily departing from the spirit and scope of the present invention. It is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative only and not limiting. Changes in detail or structure may be made without departing from the spirit of the invention as defined in the appended claims.

What is claimed is:

1. A showerhead comprising

a housing defining a chamber in fluid communication with a fluid inlet, a first bank of nozzles, and a second bank of nozzles; and

a massage mode assembly at least partially received within the chamber, the massage mode assembly comprising

a turbine;

a cam connected to the turbine; and

a shutter connected to the cam, wherein

movement of the shutter is restricted along a single axis; and

as the turbine rotates, the cam causes the shutter to alternatingly fluidly connect and disconnect the first bank of nozzles and the second bank of nozzles from the fluid inlet.

2. The showerhead of claim **1**, wherein

the first bank of nozzles comprises a plurality of first outlets; and

the second bank of nozzles comprises a plurality of second outlets; wherein

the first outlets are fluidly connected to the fluid inlet substantially simultaneously and are fluidly disconnected from the fluid inlet substantially simultaneously; and

the second outlets are fluidly connected to the fluid inlet substantially simultaneously and are fluidly disconnected from the fluid inlet substantially simultaneously.

3. The showerhead of claim **1**, further comprising at least one curb wall extending inward from a sidewall of the chamber, wherein the at least one curb wall interfaces with the shutter to restrict the movement of the shutter along the single axis.

4. The showerhead of claim **3**, wherein the shutter includes two curved edges and two constraining edges.

5. The showerhead of claim **4**, wherein

the at least one curb wall comprises two curb walls, and

the constraining edges of the shutter each engage a respective one of the two curb walls during movement of the shutter.

6. The showerhead of claim **1**, wherein the cam is eccentrically oriented relative to a center of the turbine.

7. The showerhead of claim **1**, wherein the cam is formed integrally with the turbine.

8. A showerhead comprising

a spray head;

an engine fluidly connected to a water source and received within the spray head, the engine comprising

a massage mode assembly comprising

a turbine; and

a shoe connected to the turbine, wherein movement of the shoe is restricted to a single axis; and

a face plate connected to the engine and configured to selectively rotate the engine, the face plate defining a plurality of nozzle apertures; wherein

fluid flow through the engine causes the turbine to rotate; and

as the turbine rotates, the shoe alternately fluidly connects and disconnects a first set of nozzle apertures and a second set of nozzle apertures from the fluid inlet.

9. The showerhead of claim **8**, wherein the massage mode assembly further comprises a cam interconnected between the turbine and the shoe.

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